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Review of impacts on roads sector investments on employment

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Preface

Employment is a key driver for development as it constitutes a bridge between economic growth and poverty reduction. People and households moving out of poverty most often do this through moving into more productive and decent jobs or improving existing jobs. Contrary, shortage of adequate decent employment opportunities is recognised as a root cause of migration, becoming more and more critical in view of demographic developments that will see record numbers of youth entering the labour market in the coming decades.

Placing the aim of achieving full and productive employment at the heart of development policy is therefore critical for reducing and eventually eliminating poverty, reducing inequality and addressing informality. This is also now globally recognized with the adoption of Sustainable Development Goal (SDG) 8 “Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all”

The European Commission (EC) and the International Labour Organization (ILO) recognize that achieving this goal will require an approach where the goal of more and better jobs is also integrated into sectoral and trade policies. However, this requires a shared understanding among policymakers and social partners about the positive interaction between sectoral, trade and employment policies and the elaboration of a policy framework allowing sectoral and trade policies to be formulated and implemented in a coherent way to achieve employment and development objectives.

The ILO clearly recognizes that putting the aim of full and productive employment at the heart of development policy is critical in creating decent work and fostering social justice. These perspectives reflect a commitment to the objective of creating quality jobs globally and to pursuing cooperative solutions to this challenge. In the “Agenda for Change”, the European Commission (EC) calls for a more comprehensive approach to supporting inclusive growth characterised by people’s ability to participate in, and benefit from, wealth and job creation while in its proposal for a new "European Consensus on Development" it is proposed to promote investment and innovation to boost growth and quality employment opportunities in partner countries

In order to build a shared understanding among policymakers through policy dialogue and contribute to a coherent policy framework that is centred on generating and upgrading employment, the EC and ILO have jointly initiated the project entitled “Strengthening the Impact on Employment of Sector and Trade Policies”. This project, being implemented in ten partner countries and working with national governments and social partners, aims to strengthen the capabilities of country partners to analyse and design sectoral and trade policies and programmes that would enhance employment creation in terms of quantity and quality.

This innovative project entails developing new methods and capacities to assess how sectoral and trade policies impact on both the qualitative and quantitative dimensions of employment. It requires new processes to bring together different Ministries, public and private stakeholders to have evidence-based dialogue about how their respective policies do, and could, better impact on employment.

This series of project publications aims to capture the tools, methods, and processes developed under this project, as well as the findings from implementing these in the ten partner countries. By doing so, the experience and learning of the project can be disseminated to other countries and partners for their benefit, thus supporting the integration of global and national employment objectives into sectoral and trade policies and consequently supporting the elevation of the global employment agenda and achievement of SDG 8.

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List of Abbreviations

AGETIP	Agence d'Exécution des Travaux d'Intérêt Public
CNY	Chinese Yuan Renminbi
DFID	Department for International Development, United Kingdom
DySAM	Dynamic social accounting matrix
FTE	Full-time equivalent
GDP	Gross domestic product
GNI	Gross national income
HIC	High-income country
ILO	International Labour Organization
I-O	Input-output
IMT	Intermediate modes of transport
LIC	Low-income country
LMIC	Lower middle-income country
MENA	Middle East and North Africa
NMT	Non-motorized transport
PMGSY	Pradhan Mantri Gram Sadak Yojana (Prime Minister's Village Road Scheme, India)
RA	Roads agency
TAH	Trans-African Highways
UGX	Ugandan Shillings
US$	United States Dollar
VPD	Vehicles per day

Executive summary

Introduction

As part of Component A of the joint European Commission (EC) and ILO project "Strengthening the Impact on Employment of Sector and Trade Policies", this paper reviews evidence on the employment impact of roads sector investments.[1] The aim is to support developing countries and development practitioners in analysing and designing policies and programmes to enhance the positive impact on employment.

Roads are normally one of the most important components of the physical infrastructure required to facilitate economic activities, improve access to essential amenities and promote greater social and economic cohesion. Most developing countries, principally low-income countries (LICs) and lower middle-income countries (LMICs) in the World Bank classification, suffer from inadequate roads both in quality and quantity. Hence, investment in roads is essential for supporting the development process and improving livelihoods through more and better employment. However, improving and preserving roads is a necessary but not sufficient condition for economic development because the impact will depend on complementary conditions, for example, the productive potential and competitiveness of transport services. The term 'expenditure' is more appropriate than 'investment' in that it encompasses new construction, upgrading, rehabilitation and the maintenance of roads as elements in the management of road assets.

Employment impacts of roads sector expenditure

The employment impacts of roads sector expenditure can be separated into the impact: (a) related to the expenditure; and (b) the outcome of the expenditure. The employment impact related to expenditure is direct (in roads sector works), indirect (in sectors supplying tools, equipment, materials and services for roads sector works), and induced by the additional consumption as a consequence of direct and indirect employment. Direct, indirect and induced employment effects of the investment or expenditure on roads depend on:

- types of roads, whether interurban, major rural, rural access/feeder or farm roads;
- whether new construction, upgrading, rehabilitation or maintenance;
- the technology used and its implications for the labour, local and national content.

The outcome of the expenditure is improved roads that reduce transport costs and improve accessibility. The generated employment effects from new or improved roads are rather more complex and the types of road investment and expenditure, and their rural and non-rural effects need differentiation. For the rural population and economy, the effects are:

- improved livelihoods of farmers (more productive employment);

[1] While the term 'investment' has been used, a more accurate term is 'expenditure' which includes investment activities such as building new roads and upgrading and rehabilitating existing roads and continuing expenditure in preserving existing roads through maintenance (see sections 1 and 2 for further explanation and reasons for preferring expenditure).

- additional self-employment opportunities;
- lower cost and greater ease of employment seeking.

The effects for the non-rural population and economy are lower transport costs and ease of access leading to the expansion of existing economic activities, new economic activities and related increased employment.

The overarching policy context consists of:

- total resources available and the amount allocated for roads, including making fiscal space;
- allocation of resources between road types and institutional mechanisms for managing them including the role of the private sector;
- influences on policies;
- the priority given to employment in determining the overall roads sector policy and the technology to be used in roads sector investment and maintenance.

Clarity on the strategic objectives for the roads sector determined within the context of the country's development strategy is the starting point with the objectives including the roles and complementarities of the national, regional and local networks. This would form the basis for medium-term master plans for the national, regional and local road networks with priorities for roads sector investment and maintenance programmes, and their budgetary implications.

The national budgetary situation determines the total level of expenditure and the priority assigned to the improvement and preservation of the road network, which will depend on the assessment of the roads sector and its contribution to the development objectives. Roads sector expenditure normally ranges between 2 and 4 per cent of gross domestic product (GDP) in developing countries and roads take up between 5–10 per cent of government recurrent budgets and 10–20 per cent of the capital development budgets. These could, therefore, be considered to be the broad limits within which roads sector expenditure levels are determined for most countries.

Within the given budget, the major considerations affecting the levels and distribution of expenditure and related and generated employment impacts are: (a) allocation between construction and maintenance; (b) allocation between interurban highways, and major and minor rural roads; and (c) the institutional and funding arrangements for the roads sector. The balance between construction and maintenance is often distorted by the preference for new construction over maintenance. As a consequence, most countries spend between 20 and 50 per cent of what is needed to preserve the existing road stock.

An asset management approach combined with a strategically coherent set of priorities would: (a) determine the core road networks and investment priorities (national, regional and local) based on the development objectives; (b) preserve the maintainable core network; (c) rehabilitate and maintain parts of the high priority core network; (d) upgrade and maintain parts of the core network where justified; and (e) construct and maintain new roads necessary to the development of the core network, where justified.

The broad conclusions on the expenditure related employment impact are that there is potential for expanding this impact by: (a) more labour-intensive, more precisely labour-based, methods for the maintenance of all road categories; and (b) higher labour intensity in developing and improving all categories of rural roads. Further, the use of labour-based methods for rural roads would contribute to: (a) addressing the rural unemployment and underemployment problem; and (b) supporting rural livelihoods.

A simulation for a hypothetical small- to medium-sized low-income country shows that the employment impact of roads sector expenditure could be increased more than fivefold, from under 0.4 per cent of the national labour force to about 2.0 per cent. The assumptions underlying the simulation (based on international evidence) are: (a) 50 per cent of the budget spent on construction or rehabilitation of interurban highways (labour intensity remains at 10 per cent); (b) 20 per cent of the budget spent on construction or rehabilitation of rural roads (labour intensity increased from the conventional 10 per cent to the 45 per cent considered plausible based on international evidence); and (c) 30 per cent of the budget spent on maintenance (labour intensity increased from the conventional 10 per cent to 75 per cent). The simple Excel-based simulation model could be readily used to explore alternative scenarios and implications for specific countries.

While a simulation with plausible numbers can indicate the potential for increasing the employment impact, the major challenges of bringing about the changes are at the policy, institutional and implementation levels with a need to reconsider priorities, develop capacity and change the incentive structure. Properly functioning roads agencies and funds for higher level roads, agencies and arrangements for financing and managing rural roads, and support for community-based contracting for the lowest level roads with adequate and stable funding are needed.

There are now second generation roads agencies and funds with a degree of autonomy to manage roads in many countries as well as reasonably effective management of rural roads in some countries under alternative institutional arrangements (e.g. national agencies for managing rural roads such as the Department for Feeder Roads in Ghana or private sector involvement in managing projects and programmes such as Agence d'Exécution des Travaux d'Intérêt Public (AGETIP) in Francophone Africa). However, as yet there is: (a) insufficient allocation of funds in most countries for the maintenance of the existing road network; (b) the level of autonomy of the agencies in some countries is restricted by government controls; and (c) low priority is given to the rural roads network. Introduction of the employment-intensive approach also requires policy and implementation changes.

Employment impact of improved roads

The developmental employment impacts of improved roads are more complex and context specific and, potentially, much higher and longer term, but the nature and level of impacts depend on complementary inputs and conditions. Lower transport costs contribute to increased economic activity by reducing input costs and improving access to markets and, hence, more employment in the expanded and additional economic activities. There are challenges in estimating the employment impacts associated with the developmental effects of improved roads because:

- the impacts are more context specific and differ between rural and non-rural situations and, within each context, the nature of the development effects and the potential for development vary;
- the impacts are not just changes in the quantity of employment but also in the quality; and
- there are more fundamental transformational longer effects on the economy and society with related employment impacts, which cannot be readily captured by conventional measures of employment and quantitative modelling.

In spite of the above qualifications, it is possible to: (a) provide a range of figures of the developmental employment impact at the macro level; and (b) outline some trends and factors influencing the nature and magnitude of developmental and employment impacts.

At the macro level, growth in stock of road assets contributes to growth in GDP and employment. Empirical studies suggest that GDP elasticities with respect to changes in the stock of infrastructure (or roads sector capital) are mostly in the 0.04–0.12 range (implying a 1 per cent increase in the stock of roads leading to 0.04 to 0.12 per cent increase in GDP per year). Employment elasticities with respect to change in GDP vary between countries and are mostly in the 0.25–0.75 range depending on the labour intensities of productive sectors and the sectoral composition of growth. Based on the range of elasticities referred to above, the range of employment elasticities with respect to roads sector capital are in the 0.01–0.09 range. While the elasticities appear to be small, they represent continuing impacts for a sequence of years resulting from the infrastructure investment.

The range of GDP and employment elasticities have been used to calculate employment impacts in the hypothetical case used for the expenditure impact simulation. At the low end (i.e. assuming low GDP and employment elasticities), the impact is an increase in employment of 0.43 per cent per year of the labour force and the annual rate of return to the economy of the investment expenditure (increase in output net of the cost of preserving the asset as a percentage of the capital cost) is 11 per cent. At the medium and high levels, the annual generated employment impacts of one year's roads sector investment expenditure are 1.73 and 3.9 per cent of the labour force, respectively, and the rate of returns are 24 and 38 per cent, respectively.

There are some challenges in interpreting and using the evidence. If the focus is on preserving the stock of roads at a good standard and making incremental improvements and additions, it is not clear whether the measures of infrastructure used in macro studies (increase in the stock of roads) capture the effects of such changes sufficiently well. The wide differences in GDP and employment elasticities may either reflect differences in methodologies and data between studies or actual differences between countries, To the extent they reflect the latter, they indicate that countries with low GDP and employment elasticities have scope for improving the economic and employment impacts through changes in policies and their implementation.

Further, the macro-level studies do not reveal the complexities of the employment impact of improved roads in rural areas where there is a high level of self-employment in the informal sector and underemployment with associated poor livelihoods but low open unemployment. In these circumstances, the employment impact may not manifest itself in increased employment but in a reduction in underemployment and a shift of employment to more productive activities. Further, there is evidence that improving basic access through low-cost improvement of lower category roads for rural areas, which are very poorly served, has a high impact by improving livelihoods through more productive self-employment or new employment opportunities.

The nature and level of competition in transport service provision, and the costs imposed by regulations, influence the level of generated growth and employment effects. Generally, the lower the intensity of competition and the higher the barriers to entry into the transport services sector, the lower the economic growth and employment gains from improving roads.

There is a distinction between the market structure, demand and supply features of transport services on rural roads and interurban highways. On rural roads there is scope for local service providers to enter the market with lighter vehicles, which would weaken the market power of larger commercial operators. However for this scope to be developed, there is a need to support local small-scale service providers using intermediate means of transport (IMTs) and to avoid over-regulation, which imposes entry barriers for small-scale operators. On the more important rural, interurban and international roads more rigorous use of competition policy to reduce collusion and cartelization is needed, and the

application of traffic inspection and regulation regimes are transparent and free of irregularities which impose costs.

The focus of this paper has been on the positive employment impacts of roads in developing countries. Further, the advent of information and communication technologies are already augmenting and transforming the impacts of improved roads. However, there are also some adverse economic impacts and externalities that need to be considered in analysis and policy formulation. The economic impacts are for those who lose from improved roads and communications, while the adverse externalities are the spread of diseases, an increase in the incidence of accidents, and environmental pollution.

Lessons for analysis and policy

In order for the roads sector in developing countries to fulfil its employment impact potential with a pro-poor orientation, the allocation of expenditure towards rural roads and the maintenance of the whole network need rebalancing or increasing. This can be achieved by: (a) initiating policies to introduce, establish and promote appropriate labour-based methods for the construction and maintenance of different categories of rural roads; and (b) designing roads appropriate for their intended use. The rebalancing in favour of rural roads and the labour-based approach would be pro-poor in the sense that there is a higher concentration of poverty in rural areas so the poorest sections of the rural population would benefit more from participating in the works and from the improved roads.

In many developing countries, there is a road infrastructure deficit and a need to increase public sector expenditure or promote private sector involvement. Clearly, the guiding principle of prudent asset management is a sound basis for achieving the economic and employment impacts efficiently and effectively within the available resources. While higher expenditure on rural roads would increase the employment impact, the level of expenditure has to be economically justified, and adequate resources provided to maintain both the existing assets and the newly created ones. In summary, the asset management approach would: (a) determine the core national, regional and rural road networks and investment priorities based on the development objectives; (b) establish maintenance regimes for the maintainable core networks; (c) rehabilitate and upgrade parts of the core network that have been identified as having the highest priority based on the development objectives, and include them in the maintenance regime; and (d) construct the new roads necessary to further develop the core network where justified by the development objectives, and ensure that they are included in the maintenance regime.

An important consideration from the perspective of efficiency and effectiveness is that the technical specifications of the roads should be consistent with their intended functions and use. Hence, while access to rural areas is important, given the nature and level of usage of the roads and tracks required for rural access, the investment and preservation costs per unit for such rural infrastructure is typically a fraction of the cost of higher category roads. Further, there is evidence that the generated economic and employment benefits can be much higher for rural transport infrastructure investment and preservation in relation to the costs than for investment in higher category roads. Such expenditure, complemented by appropriate policies, also have the distributional advantage of the benefits reaching the poorer sections of the population. There are further favourable employment impacts because of the suitability of using labour-based methods for the construction of lower category rural roads.

A question of concern is the opportunity cost of investment and, more broadly, expenditure in the roads sector. Since the source of funding is predominantly public sector, the issue of whether this expenditure crowds out other expenditure, especially private

sector investment which may offer higher economic and employment benefits, has been raised in line with the broader literature in this area. The rationale, supported by the conceptualization based on endogenous growth theory, is that infrastructure investment, including transport infrastructure investment, made on economically justifiable grounds increases the rate of return of private sector investment and activities, and therefore "crowds in" private sector investment. This is likely to be especially the case in developing countries with infrastructure deficits which constrain economic development. Further, while the roads sector expenditure in developing countries is predominantly public sector in the sense that decisions to commit the expenditure are made by the government or public sector agencies, a substantial proportion of investment expenditure is externally funded either from grants or concessionary loans in developing countries.

Providing lessons for analysing and designing policies to increase the employment impact of roads sector expenditure and improved roads, the outcome of the expenditure, is a core aim of this paper. Therefore, the lessons are drawn together in the summary table below (copy of table 17 in section 6) under five broad areas: (a) national policies and strategies; (b) coherence of the core road network, and its development and preservation; (c) managing and financing the road networks; (d) investment and maintenance strategy; and (e) transport services. The differences between countries and localities in the nature and magnitude of economic and employment impacts demonstrated by the macro and micro level studies demonstrate that there is scope for countries with less good performance to learn from the better performing countries.

Lessons for analysis, policy and programme design: Summary table (also Table 17 in the paper)

Areas	Analysis (studies)	Policy and programme design	Employment impact
National policies and strategies	Assess the role of the roads sector in the national, regional and rural development and employment strategies.	Develop policy and strategy for the roads sector consistent with the national, regional and rural development and employment strategies.	***Investment and maintenance works*** • The balance between: (a) investment and maintenance; and (b) higher specification and paved interurban and lower specification rural roads affecting the employment impact. • The impact would be augmented by adopting labour-based maintenance for the whole network and labour-based construction and rehabilitation of rural roads. ***Developmental*** • The objective of the policy and network coherence should be to optimize developmental, and distributional and related employment impacts.
Coherence of the core network and its development and preservation	Consistent with the development strategy, develop the principles for specifying the coherent core network (national, regional and local) to include specification of the functions and technical aspects.	Identify coherent and complementary national, regional and local networks, and related master plans, with priorities for roads sector investment and maintenance programmes.	
Managing and financing the road networks	Appraisal to determine the appropriate legal and financial frameworks within the country context for: • the national network (to include interurban highways); • the rural road networks at different levels.	Establishment of management structures, accountability and financing arrangements to include: • an autonomous roads board and fund; • public-private partnership where appropriate for national highways; • local ownership including community ownership with support for the lower category roads; • decentralized decision-making and accountability.	***Investment and maintenance works*** Effective management and financing of all parts of the roads sector to maximize the employment impact using the labour-based approach, as appropriate. ***Developmental*** Effective management and financing of all parts of the network to improve and preserve the road network for developmental impact.

Areas	Analysis (studies)	Policy and programme design	Employment impact
Investment and maintenance strategy	Road classification based on function and traffic volumes and types and inventories. Appraisals to determine the appropriate construction and maintenance regimes. Assessment of: • employment impact potential of roads sector investment and maintenance including through labour-based methods; • obstacles to the use of the appropriate labour-based approach (institutional and capacity related). Recommendations on: (a) the appropriate use of labour-based methods; and (b) removal of obstacles.	Policies in line with the road classification, and construction and maintenance regimes determined by the analysis.	***Investment and maintenance works*** Employment impact is determined by: • the balance of: (a) construction and maintenance; and (b) highways and rural roads; • adoption of labour-based approach for maintenance of all roads and rural roads construction. ***Developmental*** Higher developmental benefits and their appropriate distributional and employment impacts (augmented by the appropriate use of labour-based methods).
Transport services	For national (including interurban) highways and major rural roads: • appraisal of the effects of transport service cartels, regulations and other impediments to passing on lower costs to end-users, and improving transport services; • recommendations on the removal of these barriers. For rural roads (major, feeder and farm): • appraisal of regulations and other impediments to passing on lower costs to end-users and improving transport services; • recommendations on the removal of these barriers; • appraisal to determine the initiatives needed to support micro- and small-rural enterprises to enter the transport services market, and innovations in developing IMTs.	Implementation of policies and initiatives based on the analysis and resulting recommendations on: • competition policy to make transport service markets more competitive and lower entry barriers; • initiatives to provide credit for and promote innovations in intermediate modes of transport (IMTs).	***Developmental*** Higher developmental benefits of lower transport costs, and improved availability and quality of transport through: • increased competition and removal of impediments (higher level roads); • increased competition and innovations in non-motorized transports (NMTs) and IMTs on rural roads. The higher developmental benefits leading to employment impacts.

1. Introduction: Context, scope and plan of the paper

Whether they are farmers, employed or self-employed in the formal or informal sector in rural or urban areas, poor or somewhat better off, most people derive much of their livelihood from work. Hence, the level of employment, the quality of jobs, and the access to decent earning opportunities are the means by which most people gain from economic development. Therefore, employment generation orientation is an important consideration in crafting national development strategies. The need for this orientation is reinforced in many developing countries[2] by the high levels of unemployment, underemployment and associated incidence of poverty.

In the "Agenda for Change", the European Commission (EC) calls for a more comprehensive approach to supporting inclusive growth characterized by people's ability to participate in, and benefit from, wealth and job creation. These perspectives reflect a commitment to the objective of creating quality jobs globally and to pursuing cooperative solutions to this challenge. An important part of this challenge is to ensure that economic growth and integration with global markets result in productive employment, decent work and poverty reduction. The EC and ILO have partnered to jointly implement the project "Strengthening the Impact on Employment of Sector and Trade Policies". The project has two components, "Component A (Employment Impact Assessment (EmpIA) of Public Policies in Selected Sectors)" and "Component B (Effects of Trade on Employment (ETE))". The objective of Component A is to support developing countries and development practitioners in analysing, and designing policies and programmes to enhance the positive impact on employment. The agriculture, transport and energy sectors are the subjects of this component. This paper is a desk-based review of the employment impact of the roads sector as part of Component A.

It is generally acknowledged that the provision of adequate infrastructure – transport, communication, energy and water supply – is necessary but not sufficient for economic development. Roads are normally one of the most important components of the physical infrastructure required to facilitate economic activities, improve access to essential amenities and promote greater social and economic cohesion. Most developing countries suffer from inadequate road infrastructure[3] and, hence, investment in roads is considered to be essential in supporting the development process. This is the reason many donors and external agencies devote substantial resources for investment in roads, and technical assistance for improving investment and operational performance of the roads sector. For example, historically, the World Bank has committed a larger share of resources to transport infrastructure than to education, health and social services combined (World Bank, 2007). In 2013, the World Bank's total transport commitments amounted to US$5.9 billion, and rural and interurban roads remained the largest subsector, accounting for 60

[2] The term "developing countries" has been used in this paper to include countries in the World Bank classifications "Low Income Countries" (LICs) and "Lower Middle Income Countries" (LMICs). On figures updated in July 2015 (World Bank Atlas Method), LICs have 2014 gross national income (GNI) per capita of US$1,045 or less, and LMICs have GNI per capita between US$1,046 and US$4,125. The other categories are "Upper Middle Income Countries" (UMICs, GNI per capita between US$4,126 and US$12,735), and "High Income Countries" (HICs, GNIs per capita above US$12,735). While enhancing employment is important for countries at all levels of development, the focus of this paper is on developing countries and, hence, the features and issues discussed in this paper are broadly characteristic of LICs and LMICs.

[3] See section 2 for more information.

per cent of total lending (World Bank, 2014).[4] It is important to clarify that expenditure on roads is not purely investment in the construction of new roads but includes expenditure on upgrading and rehabilitating existing roads, and preserving existing roads through maintenance. Indeed, it has been recognized for some decades that focusing on new construction and neglecting the preservation of existing assets has been very wasteful (Harral and Faiz, 1988) and international policy advice continues to emphasize sustainable management of road assets.[5]

Hence, it is more appropriate to examine the employment impact of all expenditure associated with managing roads as assets and not just roads sector investment. Typically, construction of new roads, and upgrading and rehabilitation of existing roads are investment activities while maintenance is a recurrent activity, which encompasses routine maintenance, emergency works and periodic maintenance.[6] From the Employment Impact Assessment (EmpIA) perspective, expenditure on roads generates employment: (i) during construction or maintenance; and (ii) through the developmental impact of improved roads. Employment generated during construction and maintenance is through the following channels:

- employment in road construction or maintenance (direct employment);
- employment through backward linkages in sectors which provide tools, equipment, materials and services for road construction and maintenance[7] (indirect employment);
- additional employment resulting from the spending of workers engaged in roads sector works, and the suppliers of materials and services for the works (induced employment).

Evidently, the nature and extent of the employment impact depends on the specifics of the activity: (a) whether it is new construction, or upgrading, rehabilitation or maintenance of an existing road; (b) road specifications (engineering design and surface materials), which depend on the road function, whether interurban, major rural, rural access, feeder or farm roads, or urban roads and streets;[8] and (c) the technology used (e.g. whether equipment or labour-based).

We noted earlier that the deficiencies in the road network in developing countries are an obstacle to economic growth and development. The main priority of roads sector

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[4] Other multilateral and bilateral funding, and aid agencies also provide substantial resources for roads sector investment.

[5] Managing roads as an asset has been defined as a "systematic process of maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing tools to facilitate a more organised and flexible approach to making the decisions necessary to achieve the public's expectations" (OECD, 2001). We return to this issue in section 2.

[6] Routine maintenance is carried out continuously and includes clearing and reshaping of roadside drains, erosion control of shoulders and slopes, repairing potholes and clearing culverts. Emergency works are repairs to damage caused by weather events or landslides. Periodic maintenance involves reshaping the surface and resurfacing as required, repairs to structures and replacement of culverts as required. Also see ILO (2007).

[7] In principle there could also be forward linkages but these are likely to be limited for roads. For example, investment in a power generation plant requires complementary investments in the network for the investment to provide a service. There are generated benefits that could be interpreted as forward linkages. These are discussed below.

[8] This paper does not address issues related to urban roads and streets. Also not considered are international highways, a category of roads performing the higher function of international transport of people and goods.

expenditure is to improve the road network to reduce the severity of this obstacle, and enhance economic growth and development, which results in increased or better employment. This employment impact is referred to as second-order, growth-related or *generated*.[9]

As mentioned, the aim of this paper is to assess the evidence on the employment impact of roads sector investment and maintenance expenditure. Practically, the questions and issues to be addressed are briefly identified here and considered in the rest of the paper:

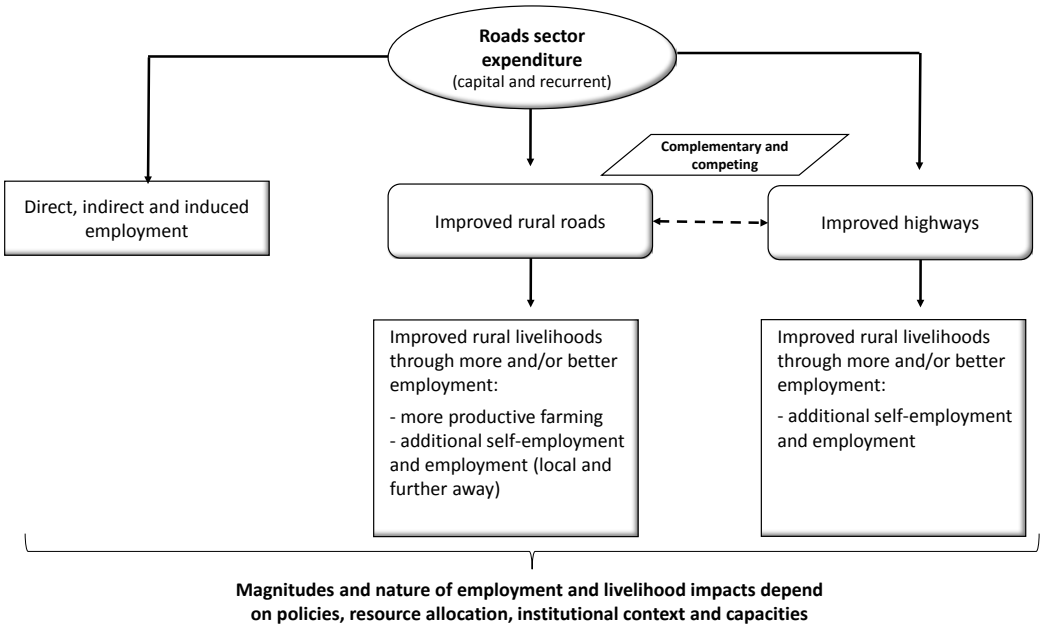
- It was observed earlier that infrastructure improvement (including roads) is a necessary but not a sufficient condition for meeting development objectives and the related employment impacts. While the initial investment expenditure and continuing maintenance expenditure may generate employment, without complementary inputs (e.g. extension services to support improvement in farming) and conditions (e.g. a competitive transport service sector), the growth related benefits may not materialize.
- A related issue is the allocation of resources within the roads sector to maximize the effectiveness of the investment. The areas to be considered are the mix between new construction, rehabilitation and maintenance, and the allocation of resources between different levels of road networks, interurban, major rural and other rural. The considerations are not just the overall economic benefits and employment impact but also distributional. For example, if there is concern about the high incidence of rural underemployment and poverty, the allocation of resources for roads sector expenditure should take into account the weight to be given to improving rural livelihoods through better or more employment. Overall, probably a balanced approach is needed since different categories of roads compete for resources but are also complementary in delivering benefits.
- Given the nature of rural economic activities, the importance of self-employment in farming or non-farming, and the high level of informality, the employment impact cannot simply be measured as the number of jobs created. For own account farmers and informal enterprises, the returns could be greater because of the lower input costs and the higher prices for produce and services, and expansion opportunities.
- There are wider questions about the economic benefits and employment impacts of the resources in alternative use, i.e. whether the resources allocated for roads sector investment could be better used elsewhere, either in the public or private sectors, and whether such alternative investments are being crowded out. Arguably, we should measure benefits net of the opportunity loss, and estimate the employment impact as net of the employment impact in the best alternative use of the resources. It is important to take into account the potential crowding out effect, but the issue is more complex because of the dynamic complementarities between improved roads and economic activities. They could have crowding in effects because improved roads reduce the costs of other economic activities, and increase opportunities to access new markets and opportunities.

Figure 1 provides an overview of the channels through which roads sector expenditure impacts employment in the short and long term, and helps to clarify the issues to be considered. The direct, indirect and induced impacts depend on the amount of expenditure, and its allocation between road categories, and between capital expenditure for investment and recurrent expenditure for maintenance, since there are differences in

[9] The term "generated" employment is used in this paper to as it depicts this type of employment impact more clearly.

the magnitude and nature of related employment impacts. The intended consequence of roads sector expenditure is to develop and preserve an affordable road network that provides a level of service supporting economic, social and wider development objectives. The employment impact of improved roads is more and/or better employment, which is a means of achieving other development objectives, such as improving livelihoods and the productive capacity of the economy.

Figure 1. Employment impact channels of roads sector expenditure



In summary the paper will address three areas:

- policies that influence investment and maintenance in the roads sector;
- investment and expenditure, and their effects on different categories of roads;
- the effects of roads sector investment on employment.

The aim is not to review the literature on the impacts of roads since a number of such reviews have already been published, including some that summarize evidence from previous reviews.[10] The idea is to use the available evidence selectively to focus on employment-related impacts to address the core objective of this paper, which is to provide an appraisal supporting the analysis and design of policies and programmes with positive impacts of roads sector expenditure on employment.

Section 2 will examine national policies and the influence of international agencies on roads sector investment and management. Section 3 assesses the dimensions influencing the relationship between expenditure on different categories of roads and their employment effects. Section 4 examines the evidence on direct, indirect and induced employment effects of roads sector investment and maintenance, and the factors influencing these effects. Section 5 examines the generated employment and productivity effects of improved roads, the outcome of roads sector expenditure, followed by a summary of findings and lessons for analysis and formulation of policies in section 6.

[10] Recent examples of reviews focusing on some or other aspects relevant to this paper are Knox (2013); Porter (2013); Starkey and Hine (2014); Hine et al. (2015).

2. National policies and the influence of international agencies on investment in roads

2.1 Introduction

This section summarizes the lessons learned on the effects of national-, local- and sector-specific policies and institutions, and external agency influences, on roads sector investments and the employment impacts of the policy combinations. Governments in developing countries are responsible for managing the roads sector, including making decisions on allocating resources for investment and maintenance, a large proportion of which comes from the public sector budget.

Public sector responsibility for roads can be justified because of a "tendency towards market failure" (Wales and Wild, 2012) because of their "public good" and "merit good" characteristics. Market failure in this context refers to inadequate provision of roads if left to market forces. It is important to examine this widely accepted view especially in the context of development to underpin the discussion on policies in this section and the impacts of improved roads in later sections. A pure public good is non-rivalrous and non-excludable. The term "non-rivalrous" refers to the use of a good by an individual or user that does not exclude its use by another individual and does not impose a cost on another user. Non-excludability means that users cannot be excluded or, more accurately, the cost of excluding users is prohibitive. Based on the above definition of public goods, it is clear that a road is not a pure public good in all cases since congestion or damage of the road by heavy vehicles imposes costs on other users, and users can be excluded, for example, on toll roads. However, if traffic volumes are low, as on rural roads and many interurban roads, public good characteristics are approximated[11] and there is a strong case for not excluding users to maximize their value adding and distributional benefits.[12]

If the public good characteristics are combined with merit good features of roads in the development context, the case for the public sector role is strengthened. A merit good provides wider benefits to society and to others than those provided to the users. These wider benefits may arise from the network externality effects of improved transport, e.g. farmers' use of lower cost transport makes better and cheaper produce available to consumers, or general contribution to improved livelihoods and poverty reduction through more or better employment.

In poor regions with low traffic volumes, the combination of the public good and merit good characteristics of roads, and the relatively heavy sunk cost of investment in roads, justifies the role of government. Policy interventions are also required to deal with negative externalities such as increased accidents and safety concerns, road damage caused

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[11] There is an alternative view that a much greater private sector role and even privatization may improve the provision of roads (Block, 1983; 2009), but this is not considered relevant to the development context. The role of private financing is referred to later in this paper.

[12] An implicit assumption in accepting non-rivalry is that there is no congestion and, hence, users do not impose costs on other users. Vehicles with axle weights that are too high for the design standard of a road would damage the road and would impose costs on other users and society, thus, contravening the non-rivalry condition.

by vehicles that are too large and heavy for the roads and, as traffic increases, pollution and congestion. Given the concerns about the nature and effectiveness of public sector management, the role of the private sector should be considered.

In summary, the main policy areas and issues that have a bearing on roads sector investment and expenditure, and their management and employment impacts are outlined below.

- Decision on the total level of roads sector expenditure (investment, maintenance and other operational activities) which requires a choice between the roads sector and alternative claims on resources, and securing the fiscal space[13] for the expenditure which includes consideration of private sector financing and user charges.
- The distribution of investment within the sector between types of roads including private sector financing.
- The institutional arrangements for managing the roads sector which include the agencies, ministries and local authorities responsible for investment and maintenance decisions, and implementation by road categories, including the prevalence of roads agencies and funds, and the private sector role.
- Wider national policies and international influences (multilateral and bilateral agencies) on policies listed below.
    - National development strategy and factors influencing national policies which include:
        - whether pro-employment and pro-poor are effective both in principle and practice (this would be evident in specific employment generation and promotion policies and programmes, and in labour market policies and regulations to optimize and promote employment);
        - policies specific to sectors (e.g. agriculture) and rural development, in particular emphasis on the development of rural transport sector infrastructure to remove obstacles to agricultural and non-agricultural development;
        - transport sector policies and regulations which influence competition and market entry, and thus the development of the sector and the transport costs for users.
    - External multilateral and bilateral agencies as:
        - national policy influencers (development and growth, employment, poverty alleviation, rural development);

[13] Heller (2005) defines fiscal space as budgetary room that allows a government to provide resources for a desired purpose without any prejudice to the sustainability of its financial position.

- influencing, with more or less leverage, transport sector policies, and the level of investment and its distribution between primary, secondary and tertiary roads,[14] and the role of the private sector;
- financing for roads sector investment:
  - loans (concessionary or otherwise)
  - grants.

o Advice and technical assistance including on the efficient and effective use of employment-intensive technology in the roads sector.

2.2 Financing transport sector investment

While the state remains responsible for roads based on the rationale outlined in the previous section, a distinction has to be made between the three core public sector roles: (a) allocation of the total funds for the roads sector; (b) its distribution between different categories of roads and between different types of interventions (e.g. construction and maintenance); and (c) the management of the budget and the roads sector. The evidence shows that there is a strong case for separating (a) and (c) and placing (b) within the scope of (c).

In this section, we consider the first public sector role (a), that of financing the roads sector.[15] It is generally recognized that developing countries suffer from an infrastructure deficit and, in particular, the inadequate provision of roads, which is both a symptom and a cause of the level of development. We provide a brief selective review of the roads infrastructure deficit. While circumstances differ between countries, the overall implication is that future economic growth would require the reduction of this deficit, and continuing expenditure on the roads sector to enable and support future growth.

One measure of road provision is road density per area but this is a crude indicator because whether the density is adequate depends on the population density and its distribution. Further available estimates vary depending on which categories of roads are included and on the reliability of the sources. Bearing these qualifications in mind, table 1 shows that the total road densities by area are clearly lower in the low-income countries (LICs) and lower middle-income countries (LMICs) than in the high-income member countries of the Organisation for Economic Co-operation and Development (OECD). There are also differences between Africa and other parts of the world. According to Foster and Briceño-Garmendia (2010) Africa's national road density is 204 kilometres of road per 1,000 sq km of land area, with only a quarter of the road length being paved. The road density in South Asia per 1,000 sq km is about 50 per cent higher while the world average

[14] These terms are commonly used to categorize roads according to their functions and importance although their precise interpretations vary. Generally, primary roads form the core network connecting larger cities and towns, secondary roads link less important population centres with each other, the primary network and the larger cities and towns. All the rest of the roads including rural roads are tertiary. Primary, secondary and the more important tertiary roads are normally classified. The terms interurban (broadly matching primary), major rural (broadly matching secondary), rural access, and feeder and farm roads and tracks (both falling in the tertiary category) have been used in this paper (see also section 3.1).

[15] The other two roles, (b) and (c) are considered in the next section.

is 944 km per 1,000 sq km, with more than half paved.[16] However, in sub-Saharan Africa, road density in relation to population is slightly higher than in South Asia and only slightly lower than in countries in the Middle East and North Africa (MENA). The density of paved roads is significantly lower in Africa as table 2 shows.

Table 1. Road density (km of road per 1,000 sq km of land area)

Year	2007
Low income	110.0
Lower middle income	260.0
High income: OECD member countries	470.0

Source: International Road Federation (2009).

Table 2 compares the density of paved roads in the LICs in Africa with that in other LICs. In spite of the low road densities, relative to GDP, many developing countries have a large existing road network, which needs adequate maintenance provision. According to Gwilliam et al. (2008), the replacement value of the existing road assets as a proportion of GDP is generally in the 10–30 per cent range though in some countries (e.g. Madagascar, Malawi, Mozambique and Niger) it exceeds 30 per cent of GDP. While the employment generation potential of maintaining the road assets in good condition would be large, this would need to be balanced with affordability.

Table 2. Density of paved roads in sub-Saharan Africa compared with other LICs[1]

Density of paved roads	Sub-Saharan Africa LICs	Other LICs
Density by area (km/1 000 km^2)	10.7	37.3
Density by population (km/1 000 population)	269.1	700.7
Density by GDP per capita	663.1	1210.0

[1] Low-income countries.
Source: Carruthers et al. (2008).

Africa Infrastructure Country Diagnostic identified spending needs on road infrastructure amounting to more than US$18 billion dollars per year in Africa. Recognizing the need for trans-African connectivity, the New Economic Partnership for Africa's Development (NEPAD) has formulated a proposal for the completion of nine Trans-African Highways (TAH) amounting to just over 52,000 km. The cost of completing the missing links in the TAH (about 25 per cent of the network that needs to be built from scratch or significantly improved) was estimated to be approximately US$4.2 billion (AfDB and UNECA, 2003). As noted in the previous section, external agencies allocate substantial resources to the roads sector in developing countries in addition to the countries' own allocations. However, the perceived needs have to be carefully evaluated and prioritized and investment programmes tailored to the available resources. A review by Dercon and Lee (2012) states that there is still "limited understanding of…what needs

[16] The International Road Federation (IRF) estimates of road density in table 1 are lower than those in Foster and Briceño-Garmendia (2010). Such discrepancies are because of differences in the categories of roads included in making the estimates, notably, whether the unclassified road network is included, and the unreliability of the estimates of this part of the network.

to be done to avoid investing massive resources in infrastructure which does not result in economic growth."[17]

The total roads sector budget is determined within the national-level development planning and budgetary processes, which may include a medium-term expenditure framework, but almost always includes an annual budget, which forms the basis for the actual disbursement. The medium-term expenditure framework provides a basis for planning future activities for ministries and agencies. However, the annual budget determines the final allocation from this source and this is subject to variations from one year to the next depending on the government's financial circumstances and external factors. Annual variations are a matter concern for the roads sector since they make it difficult to develop and implement medium- to long-term plans for investment and maintenance. This issue is briefly highlighted here in the discussion of fiscal space with more detailed discussion in section 2.3. If additional funding is required to maintain or increase expenditure in the roads sector, the options for making fiscal space include:

- direct private investment and public-private partnerships (PPPs);
- expenditure reprioritization and efficiency (shifting spending away from less productive forms of expenditure and towards growth-enhancing infrastructure investment, and improvements in expenditure efficiency);
- domestic revenue mobilization for infrastructure investment and maintenance without affecting the overall fiscal balances (ideally a proxy user charge such as a fuel levy);
- attracting additional grants and concessional finance from bilateral or multilateral sources;
- expanding sovereign borrowing on domestic or international commercial credit markets.

Clearly, private sector investment and engagement in the roads sector would be an attractive option from the budget perspective. But the regulatory conditions under which private operations could take place should generate sufficient benefits for the users and the economy, while providing an adequate return for the operator. This option for improving transport provision has generated increased private sector and government interest. However, it still remains very limited in size and scope compared with private sector involvement in other infrastructure sectors such as energy, principally because much of the transport network in developing countries has low traffic volumes. Jett (2012) reports that, during the first half of 2011, of the 22 new private sector road projects registered in the Private Participation in Infrastructure (PPI) Project Database, 19 were in India and the remainder were in Brazil, Mexico and South Africa. The scope for private sector financing is limited in smaller countries and especially for rural roads. In Africa, less than 10 per cent of the road network attracts more than 15,000 vehicles per day which, according to Foster and Briceño-Garmendia (2010), is the minimum traffic required for economically viable private sector participation. Hence, toll roads have potential only in Nigeria and South Africa.

The other methods for creating fiscal space illustrated for the United Republic in Tanzania in box 1 show that a combination of actions is needed to create the fiscal space for high priority areas with the potential to contribute to economic development, such as

[17] Evidence on the benefits of roads sector investment focusing on employment and the conditions required for it to occur is considered in section 5.

roads sector investment and maintenance. These actions indicate effective management and are mutually reinforcing. This is because, if the government is able to generate increased revenues to improve the economy and meet socio-economic targets, external support in the form of grants, loans and debt relief are more likely to be forthcoming. In addition, if the revenue generated is for specific purposes, such as roads sector expenditure and is accompanied by appropriate institutional arrangements, its use is likely to be more effective and provide the relevant agencies with a more stable basis for planning.[18]

Box 1. Evolution of fiscal space in the United Republic of Tanzania

Rapid growth in domestic revenues and external aid expanded fiscal space in the United Republic of Tanzania between 2001 and 2002, and 2007 and 2008:

- domestic revenue mobilization increased by 50 per cent from 11 to 16 per cent of GDP;
- external grants doubled as a share of national income from 3.9 to 7.8 per cent of GDP;
- external financing on concessional terms more than trebled from 1.4 to 4.1 per cent of GDP;
- bilateral and multilateral debt relief reduced the country's annual external debt servicing obligations by between 0.5 and 1.0 per cent.

Taken together, these factors allowed government expenditure to increase from 16 to 28 per cent of GDP over this period. Despite this rapid growth, levels of domestic revenues and external aid inflows were not particularly high when compared with those prevailing in similar countries in the region, suggesting that there was scope to further increase fiscal space along each of these dimensions.

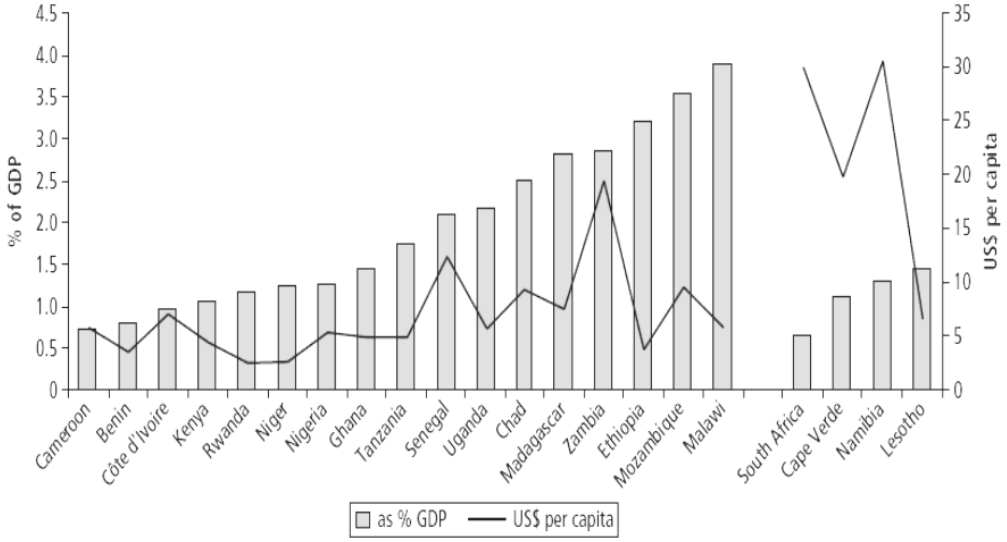
Source: Ter-Minassian et al. (2008).

On average, African countries spend US$9,000 per km for main road networks in sub-Saharan Africa and just below 2 per cent of GDP at the aggregate level. The average percentage is broadly similar to that in other developing countries and higher than the average for the high-income countries (HICs). There are, however, substantial variations between countries as figure 2 shows. The faster growing emerging economies spend between 2 and 4 per cent on roads.

For the main road network, maintenance spending ranges from about US$200 per km in Chad to more than US$6,000 per km in Zambia. Generally, maintenance spending per kilometre of the main network tends to be about twice that of the rural network. Paradoxically, LICs spend 50 per cent more per km overall than middle-income countries (MICs), while countries with road agencies and high fuel levies seem to spend somewhat less than those without. The explanation is a pronounced capital bias in road spending, with investment accounting for two-thirds of total spending in the LICs, particularly those without adequate institutional mechanisms for funding road maintenance.

[18] See section 2.3 for further discussion.

Figure 2. Average annual spending on road transport by country, 2001–2005



Source: Briceño-Garmendia et al. (2009).

A debate of some relevance here is the extent to which public sector investment in general, and in the roads sector in particular, crowds out or complements private sector investment. A reasonable consensus view from the evidence is that well-managed infrastructure investment projects (implying that investment decisions are based on sound evaluations and are well managed) complement private sector investment and productive activities by easing obstacles. Some evidence from the People's Republic of China (Xu and Yan, 2014) supports this view. Xu and Yan (2014) distinguish between Chinese government investment in what they refer to as "public goods" and infrastructure, and in private industry and commerce. The authors find that investment in public goods such as the transport infrastructure "crowds in" or complements private investment, while investment in private goods, industry and commerce, mainly through state-owned enterprises, "crowds out" private investment.

The issue of crowding out or being complementary is also relevant when considering the distribution of investment within the roads sector (e.g. between primary, secondary and tertiary roads). The different categories of roads form a network and there are, therefore, complementarities between them. If the rural roads were in a good condition but the higher level roads were not, the benefits of the former would be reduced. However, the different categories of roads and types of treatment compete for resources. There is evidence of preference for more "visible" projects in the form of new construction over preserving the existing assets through maintenance and anti-rural bias leading to the relative neglect of rural roads (Gwilliam et al., 2011).

An objective assessment is needed of the value to be derived from expenditure on different categories of roads and the appropriate types of improvement to determine the allocation of resources. In this respect, Fan and Chan-Kang (2004) show marked

differences in the output and poverty impacts of "low quality" (mostly rural) roads[19] and "high quality" (mostly interurban) roads in China (table 3). For an increase of 1 million Yuan Renminbi (CNY) of investment in low quality roads, the estimated increase in GDP is over four times that for high quality roads, and the reduction in rural and urban poverty is similarly higher. Underlying these GDP increases and poverty reduction are employment impacts.[20]

Table 3. Estimated marginal returns to additional investment in roads, China

Estimated marginal returns	Per additional km of road		Per million CNY[1] investment in roads	
	"High quality" or interurban	"Low quality" or rural	"High quality" or interurban	"Low quality" or rural
Increase in GDP (million CNY)	1.73	1.16	1.45	6.37
Rural poor lifted out of poverty (persons)	9	22	13	161
Urban poor lifted out of poverty (persons)	6	4	8	27

[1] Chinese Yuan Renminbi.
Source: Fan and Chan-Kang (2004).

2.3 Managing road investment and the roads sector

An important conclusion emerging from the previous section is that the management of the roads sector and investment in it are important for the efficient use of resources. The deterioration and deficit of these assets in developing countries referred to earlier (section 1) is partly because of the inadequate resources allocated to preserving and adding to these assets, and partly because of the management of the resources for the sector.

In most countries, the core network represents a small percentage of the total road network (by length) yet carries the majority of the traffic (in vehicles per km). In the United Kingdom, for example, over 33 per cent of road traffic is carried by just 2 per cent of roads (the 4,300 miles of core network). In India, approximately 75,000 km of national highways, a similar percentage of the 3.34 million km total roads network as in the United Kingdom, is estimated to carry 40 per cent of all road traffic (Government of India, 2011).

A major concern that emerged in the 1970s and 1980s was the serious deterioration of road infrastructure in developing countries, despite large investments in construction and rehabilitation of highways financed by multilateral and bilateral financing institutions. Harral and Faiz (1988) estimated that in the 85 countries that had received World Bank assistance for roads, a quarter of the paved roads outside urban areas, and a third of

[19] Fan and Chan-Kang (2004) refer to Expressways and Class 1 and Class II roads (broadly corresponding to "interurban highways" category in this paper though with some overlap of the Class II roads with "major rural road" category in the paper) built to high design standards at higher costs as "high quality". They refer to Class III and IV and unclassified roads constructed to lower design standards as "low quality". The average construction cost per km of "low quality" roads was estimated to be about 12 per cent of that for "high quality" roads. In the rest of this paper, we refer to "high quality" and "low quality" roads as interurban and rural roads, respectively.

[20] Increased and more productive employment is a means through which GDP increases and poverty is reduced. We return to this issue in section 5 with evidence from other countries.

unpaved roads, needed reconstruction costing between US$40 and US$45 billion. Timely preventive measures costing less than US$12 billion could have saved these roads and held down the operating costs for road users. Much of the impetus for roads sector reforms and the increased attention to maintenance came from the World Bank's Roads Management Initiative (RMI) in sub-Saharan Africa and similar initiatives in Asia and Latin America set up following the Harral and Faiz study (1988).[21]

The RMI analysis concluded that the traditional approach of public works and roads departments operating directly under the control of line ministries was not conducive to effective management. It did not deliver an adequate service to users or prevent deterioration through maintenance. A client-provider approach with an autonomous road agency executing works through consultants and contractors, and a board with strong user representation managing a dedicated road fund (referred to as second generation road funds), initially focusing on maintenance, was proposed. Foster and Briceño-Garmendia (2010) found that most countries now have such second-generation road funds or are establishing them. However, their operations, performance and effectiveness vary substantially.[22] One issue is that the fuel levies, as proxy user fees, are too low to fund road maintenance in many countries. There are also difficulties in securing the revenues because of evasion or delayed transfers. The road funds in many countries (e.g. Benin, Côte d'Ivoire, Ethiopia, Gabon and Zambia) still depend on budget allocations for more than three-quarters of their resources rather than being funded largely from fuel levies, as is the intention.

Apart from adequate dedicated funding from a proxy user charge such as a fuel levy, an important requirement for the reform process to work is the formation of autonomous agencies to manage the major highway network and set out clear lines of responsibilities and funding arrangements for the rest of the network based on: (a) clear responsibility; (b) autonomy and accountability: (c) stable financing; and (d) strong management (see box 2 for the elaboration of these features).

[21] See Heggie (1995); Heggie and Vickers (1998); Schliessler and Bull (2004); Smith (2013).

[22] See also Gwilliam et al. (2011) and Harral et al. (2011) for recent appraisals of progress on the reforms of roads sector management and the shift towards improved maintenance.

Box 2. Principles for managing and financing the roads sector

1. Responsibility: Clear demarcation of responsibilities for parts of the network between relevant agencies and management principles. A sound model would include a dedicated authority (roads agency or RA) to manage the major highway network, and clarity on responsibility for the management of the remainder of the network and its financing. For network responsibility to be assigned, completion of an up-to-date road classification, road inventory and road condition survey. For the strategic highway network, the role of the ministry would change from service delivery to a more strategic, policy development and regulatory role. The national road agency would have a duty to deliver a certain standard of service and the agency would have a clear client role with respect to its suppliers (contractors and consultants).

2. Autonomy and accountability: The dedicated RA would require autonomy and funding to operate efficiently and fulfil its function of providing a service to a sufficient standard. As an executive agency with autonomy operating on commercial principles, the RA should have a board with a strong representation of users to monitor and assess performance.

3. Finance: A dedicated road fund to provide adequate and reliable maintenance. Where funding is erratic and insufficient, the agency cannot plan its work properly and maintain adequate maintenance levels, which ultimately leads to the deterioration of the network.

4. Management and implementation capacity: Efficient management systems and procedures, and capacity building are essential. The contractors and consultants also need to be competent in management and technical aspects; they may require training.

With these principles, roads agencies could operate in a focused professional environment, and be judged on delivery of outputs and outcomes, rather than inputs. Clearer accountability through legislation, regulations and procedures are required for the agencies with respect to the spending of funds and performance. The agencies would essentially become procurement and contracting organizations managed by qualified professional staff with responsibilities and activities that would include:

- **Promoting and enabling competition** to push down prices and increase value for money. If competitive market conditions and a sufficient number of competent contractors were not available, capacity building and policies to promote contractor participation in the sector would be needed.
- **Encouraging small contractors and enabling their participation**. The agencies' terms of reference could include the promotion of national policies, such as encouraging small contractors by packaging procurement contracts appropriately. This has been done in South Africa through the South African National Roads Agency Limited (SANRAL), where previously disadvantaged groups are actively encouraged to bid for work (Pinard, 2012).
- **Encouraging innovation and initiative** within the organization and in contractors' services provision, such as performance-based management and maintenance contracts. The terms of reference could also include innovation and initiative in contributing to the national employment strategy by promoting appropriate and efficient labour-based approaches in the roads sector.

The performance of the reformed institutional arrangements has been variable and in many cases disappointing. Pinard's (2012) assessment of the performance of RAs in seven countries in sub-Saharan Africa found that the proportion of the paved network in good condition had increased more in countries with RAs run on commercial principles as outlined above than in those where the agencies continued to operate as government departments under the direction of parent ministries. Rohatgi et al. (2011) undertook a review of RAs in five countries in South Asia (Bangladesh, India, Nepal, Pakistan and Sri Lanka) and a further 17 agencies operating at state level in India, and found that the formal

creation of new institutional structures was not automatically matched by performance. Over 90 per cent of the RAs studied effectively remained government departments reporting directly to the minister and lacked stable independent sources of funds.

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Typically, RAs and road funds typically focus on the major highway networks, though road funds normally include allocations for lower level roads, which are distributed to local authorities responsible for them. However, local authorities have limited capacities for managing the roads sector and the funds available are normally not sufficient. As we will see in later sections, improving access through better roads is key for rural economic development and employment. Hence, the management of rural roads need to be guided by the principles of: (a) clear responsibility; (b) autonomy and accountability; (c) adequate and stable financing; and (d) strong management. However, setting up fully-fledged RAs for smaller local road networks is not feasible in most countries. Common models are to assign responsibility to: (a) an existing ministry, usually the ministry of works or local government; or (b) to a newly-formed special-purpose department within an existing RA or ministry.

The first model has often been associated with donor-financed projects in the absence of competent local-level RAs and so the funds are channelled through a central government ministry with responsibility for local roads. This model is generally not conducive to long-term sustainability especially if the agency responsible for the road network is not involved. In the absence of a dedicated agency, the ministry may not have the capacity or motivation to manage the local road networks effectively which involves: (a) engagement with local communities in setting priorities and planning; (b) classifying and prioritizing roads in the network; and (c) determining and implementing the level of treatment for the roads including maintenance in line with the priorities. Similar problems would arise with roads constructed by other ministries (for example, feeder roads by the ministry of agriculture).

The second model, a special-purpose department for rural roads, is better and is used in a number of countries. Ghana has special purpose departments within the Ministry of Roads & Highways, the Department of Urban Roads (DUR), to manage urban roads on behalf of municipalities, and the Department of Feeder Roads (DFR). The latter manages the rural road network on behalf of rural district councils and is often held up as an example of best practice. Bangladesh manages its rural road network through a similar central government agency (Local Government Engineering Department, LGED). The Department of Local Infrastructure Development and Agricultural Roads (DoLIDAR) in Nepal (under the Ministry of Federal Affairs and Local Development) supports the implementation of infrastructure programmes including roads at the district level through district technical offices. Even if such agencies exist, for many, capacity needs strengthening to implement programmes effectively, provide adequate funding, address the balance between new construction and maintenance, and lead innovations and capacity building for more employment-intensive approaches.

Taking into account the employment generation role of road investment, the inclusion of responsibility for developing and promoting labour-based approaches has been referred to above. While improving and rehabilitating rural roads and preserving them in good condition is very important for rural economic development, employment generation and reducing poverty, the nature and density of traffic will usually justify the types of roads for which labour-based methods are especially suited.[23] As the work of the Employment Intensive Investment Programme (EIIP) has demonstrated,[24] the scope for using labour-based methods in the construction and maintenance of local roads to combine effective and efficient works with employment generation is even greater for rural roads. Hence, these agencies should have the roles of developing and ensuring the implementation of appropriate labour-based technologies with the necessary balance between new construction, upgrading and rehabilitation.

An alternative to government agencies for rural road networks is contracting out the planning and management of these roads to private sector consultants and contractors. One such model is Agence d'Exécution des Travaux d'Intérêt Public (AGETIP), which is particularly relevant for rural roads (Foster and Briceño-Garmendia, 2010). AGETIPs have been set up in francophone Africa to manage private consultants and contractors on behalf of the public authority to perform the necessary functions for contract preparation, implementation and supervision (see box 3).

Box 3. The Role of AGETIPs in managing local road networks

The AGETIP model originates from established practice in French public administration. Under this model the functions of planning, procurement and implementation of public works are delegated to specialist private agencies. The model has been adopted by a number of mainly francophone countries in Africa. Initially, the model was attractive to donor agencies for infrastructure projects funded by them in rural areas where management and technical capacities in local administrations were low, government procedures for procurement and contracting were cumbersome, and low wages and bureaucratic structures in public administration were disincentives for staff.

The first AGETIP in Africa was set up for a donor-financed project in Senegal in 1989 and since then AGETIPS have been established in 15 countries, mostly in francophone West Africa. The agencies play three roles as: (a) competent technical agencies using private sector recruitment and payment procedures; (b) managers of special funds; and (c) planning and programming directors of local authorities' infrastructure investments. They also provide technical manuals and contractor training. Originally established to facilitate donor financing, they went on to manage nationally funded projects.

Improved administration of public works and timely payment under the AGETIP model increased the participation of small- and medium-sized enterprises (SMEs) in public works programmes, often using labour-intensive techniques. Rural roads are an important part of their work. Nevertheless, considerable room for improvement remains, particularly with respect to the AGETIPs' technical capacity, the quality of preparatory studies, contract supervision, and delays in project implementation

Sources: Diou et al. (2007); Africatip (2016).

In rural areas, there is a further category of roads and tracks below those for which local government is responsible. These are normally undesignated and uncatalogued, and are formally or informally the responsibility of sub-district or village-level administrations. While roads and tracks at this level are essential and contribute to improving poor rural people's livelihoods, the network of roads and tracks can be extensive and in very poor

[23] See sections 3 and 4.

[24] ILO (1998); EIIP (2003).

condition. To improve and preserve the roads and tracks at this level, there are two options: (i) community contracting; or (ii) delegating the work to the community. Under the former,[25] there is a contract between the community and the responsible agency, which could be a local authority or a dedicated agency to undertake the work under contract for payment. Where external or local authority resources for the development and preservation of low-volume roads and local access roads, and other local infrastructure, are limited, the latter may be projects undertaken on a self-help basis.

In Indonesia, the National Program for Community Empowerment in Rural Areas (PNPM Rural), financed by the government and supported by donor funding, is an example of probably the largest community-based contracting programme that constructs and rehabilitates roads and other infrastructure.[26] Projects are selected and implemented through a participatory process which goes through a number of steps including:[27] (a) participatory processes of proposing and selecting projects; (b) preparation of selected proposals including design and cost estimates for which the programme provides technical support through consultants; and (c) a village implementation committee supported by a technical consultant and a social adviser consultant to manage implementation using labour-intensive methods and procurement (Vaidya, 2014).

Although not solely dedicated to roads, PNPM Rural offers a good community contracting model for improving and preserving low volume roads by including three components for such a model to function effectively: (a) an incentive system in which community members can participate and receive payment for the work through a contract; (b) access to advice and technical assistance to help them carry out the work; and (c) technical and financial oversight to provide accountability for the use of funds. One concern with the PNPM, as with many other projects and programmes, is the lack of provision for maintenance leading to the rapid deterioration of assets (ILO, 2008). Possible solutions are to make evidence of maintenance of existing assets a pre-condition for approving new projects, or to include maintenance projects in the programme. For longer term sustainability, the communities need to "adopt" the roads and tracks, and take responsibility for preserving them. Since community responsibility for preservation also applies to the second option of delegating all responsibility for the roads to the community, it is elaborated after examining the second option.

Under the second option, the default position is the one that prevails at present in most localities. The consequence is that the assets are neglected with occasional emergency work being carried out by the community or the local authority. The reason for this is the lack of the three necessary conditions referred to above in connection with community contracting (incentives, technical support and oversight). However, there are projects from which some lessons can be drawn. Some community contracting projects are supported by nongovernmental organizations (NGOs) or donors that provide technical and financial support but require the community to offer unpaid labour as a contribution in kind.

Reporting on evidence from Malawi, RuralNet Associates (2005) found that there is often a lack of clarity on the objectives of such rural self-help schemes which leads to poor communities and often the poorest members of communities contributing all or part of

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[25] The ILO definition of community contracting used in this paper is "an agreement between a community and a contracting authority, whereby the community (or section of the community) is responsible for the implementation of the works and therefore functions as a contractor" (Tournee and van Esch, 2000).

[26] PNPN (2011); Holste (2012).

[27] PNPM (2013).

their labour free. RuralNet Associates (2005) also note that beneficiary communities do not welcome being required to make voluntary unpaid contributions of labour or materials as a pre-condition of external assistance. In public infrastructure works, such as roads and community access, the problem is compounded by the fact that the assets generally benefit the better off and the wider community more than the poorer members of the community who contribute their labour.

The issue of maintenance of constructed or improved roads was mentioned in connection with community contracting. The benefits that improved access to roads offer to the community are clearly an incentive. However, experience to date indicates that because of a combination of reasons (the public good feature of the asset discussed earlier, and the lack of know-how and resources), the benefits of access by themselves are not sufficient. Technical support and oversight supplemented by partial material support, for example, for the procurement of materials and transport, may be sufficient when combined with the benefits of access.

There is evidence from sparsely populated rural areas in mature economies (e.g. Canada, Finland and Sweden) where local associations have been formed to manage the road network. In Sweden, the Private Roads Act explicitly recognizes private ownership and the associations owning the roads are responsible for maintaining and paying for them through contributions (Malmberg Calvo, 1998). Similar models with qualifications are relevant in developing countries. Poor rural communities in developing countries are unlikely to be able to make sufficient financial contributions to sustain the local road network. However, contributions in kind, such as providing a proportion of labour without pay or supplying local materials, could be an option within a properly institutionalized system with technical, management and financial support.

The system would require individuals or groups to formally apply to join the agreement and to abide by its rules. In Finland, road cooperatives have been formed and, in Ontario, Canada, there are local roads boards. In Zambia, under the Social Recovery Project, communities formed road maintenance committees to obtain access to financial support from donors and the road cost sharing fund. In Lesotho, cost-sharing agreements were set up between the agency and Village Development Committees. In Nepal, local users' committees manage or implement projects, and provide funding and technical support.

The relevance for this paper of issues related to management and financing of roads is to emphasize the importance of: (a) clarity on strategic objectives; (b) adequate level of funding, allocation and management of funds (interurban highways versus rural roads, and investment versus maintenance); (c) institutional arrangements for implementation; (d) the need for public and private sector capacity development; and (e) the introduction of innovative approaches. Effective management, which would take different forms for different levels of roads, and adequate funding are essential for developing a strategy for the roads sector to increase the level of investment, and improve its employment and development impacts.

3. Road categories and employment effects: Dimensions influencing the relationship

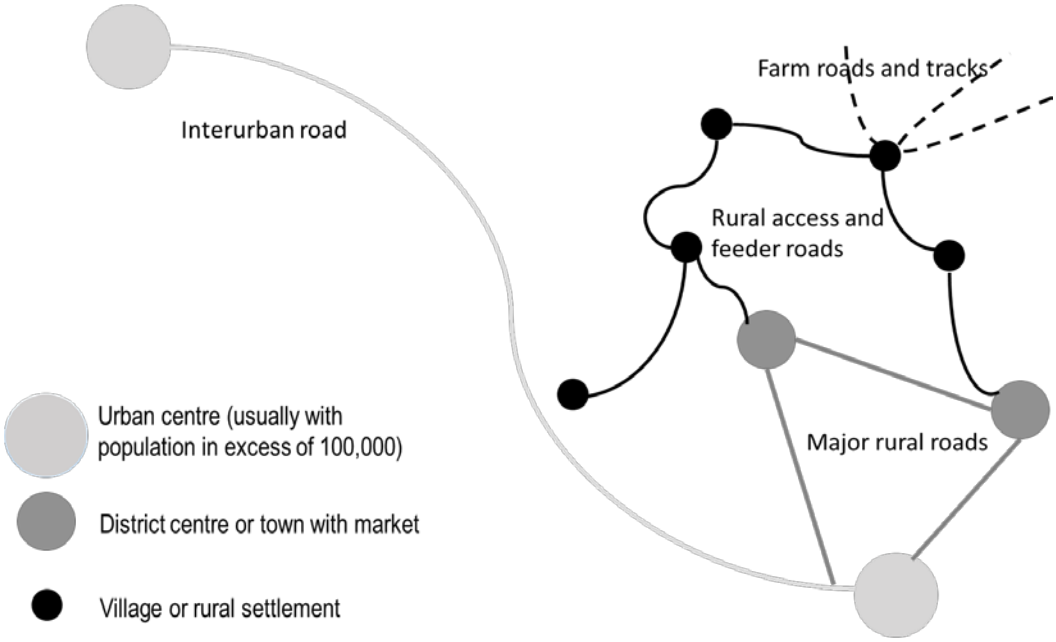
3.1 Introduction

The previous section provided an overview of the institutional dimensions affecting roads sector expenditure and its employment impact. A distinction was made between the interurban roads as parts of the network of major roads and rural roads. Reference was also made to types of users and beneficiaries, the nature and density of traffic, financing and operational aspects, such as construction and maintenance technologies, and implementation and maintenance arrangements. This section elaborates on the configuration of these elements for each road type with the help of table 4.

3.2 Dimensions influencing the employment impacts of roads investment

The four road categories introduced in section 1 are shown schematically in figure 3 and are largely self-explanatory. Major interurban roads connect larger urban centres. Typically, a minimum population size of 100,000 is specified for urban centres, but the size and number of urban centres vary a great deal between countries depending on their population and level of urbanization. The types of economic activities also vary a great deal with predominance of the market function in some urban centres, and a range of activities including services and manufacturing in others. As a consequence, within the interurban roads category, there could be large variations in traffic volumes and road specifications.

Figure 3. Road categories and functions



Major rural roads connect district centres and towns with each other, major interurban roads and urban centres. They may also serve larger collector markets for the surrounding villages and rural settlements. Rural access and feeder roads connect villages and smaller rural settlements with each other, rural markets, district centres, and major rural and

interurban roads. In addition, rural settlements rely on roads and tracks for mobility within the settlement, for example between farms and homes, and for other essential activities, such as fetching water and collecting firewood.

There are differences in the density and mix of traffic between the road categories related to the number and types of users and, hence, the level and nature of economic, social and employment effects. A distinction is made between the developmental effects, and the roads sector expenditure-related effects for the road categories. The developmental effects of expenditure on minor rural roads[28] improve the livelihood prospects of local farming households, but such households would also benefit from improved higher category roads (major rural roads and highways) which have wider economic, social and employment effects by improving access and economic activities over wider areas. The trade-off is between relatively lower levels of expenditure per kilometre for minor rural roads over a larger network and higher level of expenditure per kilometre for fewer kilometres of the higher level network. Some evidence on the relative economic and employment impacts of expenditure on rural roads and higher category roads is discussed in section 5.[29]

The employment effects of roads sector expenditure also differ between road categories. The appropriate design and technologies, and hence the potential employment intensity and effects also vary between road categories with generally higher employment intensity for lower level rural roads and tracks. The design and technologies have implications for the nature of maintenance, and the effectiveness of maintenance affects the quality and durability of the roads and their developmental employment effects. Table 4 outlines these aspects for each road category with special reference to their employment generation potential which is influenced by the nature of beneficiaries and types of benefits improved roads offer. Sections 3.3–3.6 use the table to highlight features that are different for the road types and section 3.7 brings together some common themes. The empirical evidence is discussed in sections 4 and 5.

3.3 Farm roads and tracks: Intended user groups, benefits and context

The primary functions of these roads and tracks are to provide access for farming, carrying farm produce and farm inputs, for other economic activities (e.g. fishing) and essential non-economic transport needs (e.g. fetching water and firewood). Traffic will generally be very light, either on foot, via IMTs including non-motorized transport (NMT), and smaller motorized vehicles (e.g. motorcycles with and without trailers) with a very limited number of smaller commercial trucks, vans and cars. Clearly, it is essential to maintain basic access to farms and other locations important for economic and non-economic reasons. Table 4 summarizes the employment effects of the different road categories and the dimensions influencing the relationship.

The main benefits of preserving these assets in a serviceable condition are that they save time and effort, especially if they are in good enough condition for access by IMTs for much of the year. Hence, the level of investment required will be relatively low. The design has to be appropriate for the type and function of the road, and the nature and intensity of the traffic. In most cases, they may not require all weather access (Lebo and

[28] The term “minor rural roads” has been used here to include rural access and feeder roads as well as farm roads.

[29] See also table 3 in section 2.2 and related discussion.

Schelling, 2001; Starkey and Hine, 2014). For farm roads, basic engineering design for single-track earth or gravel roads would be adequate in most cases and the labour intensity in construction, rehabilitation and maintenance would be high. Given financial and resource limitations, improving them typically has low priority with emphasis being given to keeping the most important roads and tracks in a serviceable condition.

As noted in the previous section, these roads and tracks will generally be unclassified and undesignated with no clear responsibility other than at the sub-district or village level. It is commonly specified that the communities are responsible for these roads, implying that the communities would need to voluntarily rehabilitate or maintain them. However, relying on voluntary contribution of labour is not effective and puts an added burden on local people. At this level, the main focus is likely to be on preserving the most important tracks. Community-based contracting or use of petty contractors could be effective with greater local accountability. Both approaches would require a budget (e.g. as in the case of the PNPM in Indonesia discussed in the previous section), with some technical support, and contract supervision and management to ensure standards, and the appropriate use of local resources and labour to preserve roads and tracks at an adequate level.

Community-based programmes could combine the objectives of preserving assets and supplementing local livelihoods. While the work would be labour intensive, if it were limited to keeping the roads and tracks in a serviceable condition, the labour requirement and employment impacts per kilometre would be low, about 0.4 of full-time equivalent (FTE) annual employment per kilometre with a wide margin on either side depending on the initial state of the assets and local conditions. The total impact would depend on the total road and track length to be preserved, which in turn would depend on local needs and available resources. The labour requirement is broadly similar to routine maintenance requirements, which according to ILO (2007) are one person per 2–3 km road section for rural roads under average conditions. However, it should be noted that the types of work are not what is conventionally referred to as routine maintenance[30] but spot repairs and emergency works. A project in Yunnan Province in China provides some insights (see Box 4).

The general improvement that investment at this level implies may have a marginal effect on lowering the cost of seeking employment outside the localities because the aim of the improved access is principally to improve the transport of produce and inputs at a highly localized level, and reduce the travel time and effort to meet essential household needs. For local farming or non-farming self-employment, the quality of access provided by roads and tracks, combined with the lower cost and ease of transport resulting from higher level road improvements, will have more significant effects of lowering the costs of widening job search and, hence, make the pull influence of employment opportunities further afield more attractive. In section 5, we present evidence that investment to improve access at this level is highly effective in improving rural livelihoods, with implications for the distribution of investment between categories of roads.

[30] See section 1, especially footnote 5.

Box 4. A community-based road "maintenance" programme in Yunnan Province, China

Yunnan is one of the poorest provinces in China. Because of resource limitations combined with the need for improving and maintaining the higher category roads, rural road maintenance has long been underfunded. The province has spent less per kilometre on rural road maintenance than on trunk roads by a factor of 25. Maintenance of some township and village roads, especially unpaved roads, is currently carried out on a voluntary basis. Voluntary labour contributions of nearby communities of 2–3 days per year is unreliable with low motivation of participants and insufficient input and it is, therefore, not sufficient to prevent road deterioration.

On a pilot project in a poor ethnic minority area in Yunnan Province partly supported by external funding, 163 women working in teams on average for 110 days in the year "maintained" 165 km of rural gravel and earth roads. A large part of the work was the removal of landslides, and repairs to road surfaces and shoulders. Hence, it was not conventional routine maintenance but essential and emergency repairs to maintain access. About 85 per cent of the expenditure was on labour, the rest on tools, safety equipment, accident insurance and the transport of materials. Assuming 260 work-days per year, 110 days is equivalent to just over 0.4 persons per km or 2.5 km per person.

The approach faced two sustainability obstacles. First, the local authority did not consider the expenditure levels per kilometre sustainable because of resource limitations. Second, owing to a lack of capacity at the local level, adequate supervision was difficult to maintain.

Sources: ADB (2011; 2013).

Table 4. Road categories and employment effects: Dimensions influencing the relationship

Characteristic	Farm roads and tracks	Rural access and feeder roads	Major rural roads	Major interurban roads
Intended user groups and beneficiaries	Farmers – quality and quantity effects on produce – more production of cash crops and other marketable farm produce, less deterioration of perishable products, higher prices for products. Buyers of farm and other produce. Suppliers of inputs and consumer products. Transport service providers – almost entirely local smaller operators using IMTs.	Most users similar to "farm roads and tracks" type but balance more towards buyers of local produce and suppliers of inputs and consumer products. Significantly higher volumes than for farm roads and tracks (collector function and longer distances). In addition, personal users for employment seeking, business and personal reasons. Some motorized commercial transporters including IMT operators.	"Rural access and feeder road" user types represented but balance more towards buyers of local produce, suppliers of inputs and consumer products, and commercial transporters – more commercial transporters, some larger. Significantly higher volumes than for rural access and feeder roads (collector function and longer distances). More personal users for employment seeking, business and personal use than for rural access and feeder roads.	Much larger number of commercial transporters of goods and people. Direct users (own transport) - leisure, personal and business. Longer journeys than for other categories.
	Very low with predominance of pedestrians (with or without loads), non-motorized vehicles (animal drawn, bicycles or bicycle-pulled trailers) and some motorized vehicles.	Low with traffic types as for "farm roads and tracks" but more heavily weighted towards light motorized plus some heavier motorized traffic (light trucks).	Significantly higher traffic than on "rural access and feeder roads".	Very high traffic levels in comparison with rural roads.

Characteristic	Farm roads and tracks	Rural access and feeder roads	Major rural roads	Major interurban roads
Financing	Typically these roads will be undesignated and by default the responsibility of sub-district administrations and villages. There will be no funding other than local contributions unless there is a community contracting-based programme or work through community responsibility (with or without external support).	Typically these roads are the responsibility of local authorities. Financing of investments and maintenance will be from central government allocation typically through the local government ministry and local taxes. Some road funds have allocations for maintenance of this level of roads. Resource limitations often mean that only some of the roads can be preserved in reasonable condition with the remainder neglected, possibly to be improved or maintained under a community-based approach. In some low-income countries, the budget may be supplemented by donor grants and multilateral agency grants or loans at concessionary rates. Local contributions based on user charges for investment are rare though there are examples of user charges for maintenance. Some roads could be under line ministries, e.g. feeder roads under the ministry of agriculture.	Typically, these roads are the responsibility of local authorities. Financing of investments and maintenance will be from central government allocation typically through the local government ministry and local taxes. In addition, some road funds have an allocation for maintenance of this level of roads. These roads will have higher priority than “access and feeder roads” and so will be more likely to be in a better condition. In a few cases, in some LICs, donor or multilateral agency grants or loans at concessionary rates may supplement the budget. Local contributions based on user charges for investment are rare though there are examples of user charges for maintenance.	Financing of investment (new construction, rehabilitation or upgrading) will typically be from the development budget allocated for the roads sector, but the way in which it is disbursed will depend on the institutional arrangements, either through the line ministry and road agency under it or an autonomous road agency (see section 2). A high proportion of the infrastructure development budget comes from multilateral and bilateral donors. Some private participation on large infrastructure projects in some countries.

Characteristic	Farm roads and tracks	Rural access and feeder roads	Major rural roads	Major interurban roads
Technologies and designs	Given the design requirements for roads for farm access – relatively short, single track, unpaved earth or gravel – could provide all weather or part year access depending on requirements. Constructed, rehabilitated and maintained through community-based labour-intensive methods providing paid employment if through community contracting or community responsibility with external support. Technical support for very basic design and supervision required.	Depending on traffic conditions and other conditions, they could either be gravel or low-cost sealed surfaces to provide the appropriate level of access. Construction, rehabilitation and maintenance highly suited to labour-based methods. Such an approach is also likely to be less costly compared with equipment-based approaches.	Depending on traffic and other conditions, they could either be gravel or low-cost sealed surfaces to provide the appropriate level of access. Construction, rehabilitation and maintenance highly suited to labour-based methods. Such an approach is also likely to be less costly compared with equipment- based approaches.	Fully engineered sealed roads with design specifications dependent on traffic types and levels. Normally implemented by equipment-based methods with some prospects of increasing the employment content.
Implementation arrangements	The options are: (a) community contracting; or (b) community responsibility (see section 2). There needs to be provision for technical support for planning, design and supervision.	The three main options are: (a) direct implementation by agency (local authority supported by its own engineering department or a national rural roads/infrastructure agency) through contractors; (b) AGETIP form of contracting out management; or (c) community contracting.	If under local authority responsibility, the two main options are: (a) direct implementation by agency (local authority supported by its own engineering department or a national rural roads/ infrastructure agency) through contractors; or (b) AGETIP form of contracting out management. Some more important roads may be part of the core highway network (see implementation arrangements for major interurban roads).	The executing agency will be a more or less autonomous road agency or a department under a ministry depending on the status of reforms, typically implementing through contractors.

Characteristic	Farm roads and tracks	Rural access and feeder roads	Major rural roads	Major interurban roads
Maintenance	Basic maintenance at community level – typically community responsibility. Maintenance is typically emergency works to preserve essential access. Support with materials and technical guidance would improve performance.	Maintenance (routine, emergency and periodic) is important for preserving roads as assets and providing access at low lifetime costs. Maintenance is more labour- intensive with potential for more employment per unit of expenditure in routine and periodic maintenance as in construction and rehabilitation. But maintenance is often neglected because of insufficient resources, weak institutional arrangements and preference for new construction.	Maintenance (routine, emergency and periodic) is important for preserving roads as assets and providing access at low lifetime costs. Maintenance is more labour- intensive with potential for more employment per unit of expenditure in routine and periodic maintenance as in construction and rehabilitation. But maintenance is often neglected because of insufficient resources, weak institutional arrangements and preference for new construction.	Maintenance (routine, emergency and periodic) is important for preserving roads as assets and providing access at low lifetime costs. Maintenance is more labour-intensive than construction/rehabilitation with potential for more employment per unit of expenditure, especially in routine maintenance. But maintenance is often neglected because of insufficient resources, weak institutional arrangements and preference for new construction.

Source: Developed by author.

3.4 Rural access and feeder roads

This category of roads is a significant level up from farm access roads. For farmers and other rural producers, improvement of this category of roads has the potential to reduce costs of transporting produce to markets, higher level roads and population centres. Because of the level and functions of this category of roads, the volume of traffic related to farm produce will generally be much higher than the previous category. Further, there will be an added category of users; people travelling to work, seeking employment, meeting household needs and travelling for leisure. Some vehicles such as buses, vans and trucks provide more than one type of service (e.g. vans carrying passengers and goods). Generally, motorized traffic volumes will be low, at the lower end of the 20–200 vehicles per day (VPD) considered to be typical of rural VPDs and could even be below the lower end of 20 VPD depending on the context. There will be a predominance of pedestrians, bicycles and other IMTs.[31]

Maintenance is important to ensure that roads continue to generate benefits for users. As noted in table 4, for this category of roads, the maintenance requirements are proportionally higher in relation to the investment cost and maintenance of the roads would be highly labour-intensive. Hence, in addition to employment generation during labour-based construction or rehabilitation, there would be potential for continuous employment generation for routine and periodic maintenance, and emergency repairs.

Depending on the nature and volume of traffic, the roads could either have gravel or low-cost sealed surfaces to provide the appropriate level of access. Labour-based methods are suited to the construction, rehabilitation and maintenance of such roads. This approach is also likely to be less costly compared with equipment-based approaches. Maintenance is more labour-intensive with potential for more employment per unit of expenditure in routine and periodic maintenance. However, maintenance is commonly neglected because of insufficient resources, weak institutional arrangements and a preference for new construction.

Typically, these roads are the responsibility of local authorities although some roads could be the responsibility of line ministries, for example, feeder and access roads under agriculture and forestry ministries. Financing of investments and maintenance will be from central government allocation, typically through the local government ministry and local taxes (excluding roads under function ministries), and road funds where they have an allocation for maintenance of this level of roads and major rural roads (see section 3.5 below). Resource limitations often mean that only some of these roads can be preserved in a reasonable condition with the remainder neglected, possibly to be improved or maintained under a community-based approach, if the communities consider such improvements important, and they have the appropriate capabilities and support.

In some LICs, donor and multilateral agency grants or loans at concessionary rates may supplement investment and maintenance budgets. In such cases, labour-based approaches are typically favoured and have employment generation impacts (see section 4). Local contributions based on user charges for investment are rare although there are examples of user charges for maintenance.

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[31] See sections 3.5 for more details on traffic levels and section 3.7 for the role of IMTs in the transport service market

Overall, a strategic approach taking into account the rural and national development priorities is needed to identify the most important roads in this category to be constructed and maintained within the available budget. The construction and maintenance of this category of roads are likely to be particularly suited for labour-based methods. The management approach should be appropriate for effective implementation and introduction of the labour-based approach and, therefore, initiatives to develop the necessary management and technical capacities would be required.[32]

3.5 Major rural roads

As figure 3 shows, for the rural economy major rural roads: (a) perform the wider collector function to move local produce to larger markets and smaller local urban areas; (b) transport consumer goods to larger rural markets and district-level population centres; and (c) enable people to travel for economic (trade, work and job seeking) and household and social purposes. In fulfilling these functions, they provide links for rural people with the interurban network and larger urban centres. Given their collector function, they serve larger rural areas and, hence, the volume of traffic is also higher than on rural access and feeder roads, typically in the 20 to 200 VPD range.

While these traffic volumes appear low, they need to be put into context with the qualification that there is no acceptable definition of low volume in relation to rural roads and traffic volumes on rural roads vary substantially between countries. Faiz (2012) places roads with motorized traffic below 1,000 VPD in the "low volume" category. The Transport Association of Canada puts the threshold at 200 VPD, while the American Association of State Highway and Transportation Officials (AASHTO) places it at 400 VPD. Table 5 shows the high proportion of roads globally that have relatively low traffic volumes.

[32] See sections 2.2 and 2.3 above for management reforms conducive to labour-based methods, and section 4.1 for obstacles to their introduction.

Table 5. Average daily traffic by proportion of the global network

Average daily traffic	% of global network
< 400	70–75
< 1 000	80–85
< 5 000	98

Source: Faiz (2012).

The improvement of major rural roads (along with the access and feeder roads considered in section 3.4) has the potential to reduce the costs of transporting rural produce to local markets, and to higher level roads and population centres to reach markets further afield. The gains for rural producers range from lower costs for their inputs and higher prices for their outputs. For consumers, they include lower costs of products and services (including transport services). Further, there are the direct effects on employment related to increased traffic and induced employment effects associated with increased consumption.

The nature of the employment impact of rural roads (major roads and the other rural roads and tracks categories) also needs to be addressed. In low income countries (LICs), lower middle income countries (LMICs) and upper middle income countries (UMICs), a significant number of farmers are self-employed with members of households engaged to a lesser or greater extent on the family farm, and in other farm or non-farm employment. The World Bank (2008) notes that rural households engage in farming, local employment and migration, but one of these activities usually dominates as a source of income. Five livelihood strategies are distinguished: (i) smallholders who derive most of their income from actively marketing their produce; (ii) subsistence farmers who use the majority of their produce for home consumption; (iii) households relying primarily on work in agriculture, or the rural non-farm economy, or on non-agricultural self-employment; (iv) households primarily relying on remittances from members who have migrated; and (v) diversified households which combine income from farming, off-farm labour and migration.

The nature and magnitude of the economic and employment impacts at the household level depend on its livelihood strategy. Further, since there are differences between countries and localities in the mix of household livelihood strategy types, the development and employment impacts of improved transport infrastructure vary. In some countries (e.g. Bangladesh and India), the proportions of landless and functionally landless households[33] are high. For example, in India the proportions are 31 per cent landless and a further 30 per cent functionally landless (with less than 0.4 hectare of land) (Basole and Basu, 2009). In 2007, in Bangladesh, 59 per cent of households were either landless or functionally landless (owning less than 0.2 hectare of land) (Hossain, 2009). Viet Nam has virtually no landless rural households.

For market and subsistence farming households, the impact may not be additional jobs but fuller and more productive work on the farm with the former expanding their production for marketing and the latter diversifying into production for sale because of better access to markets. However, whether these households benefit from improved

[33] A household is categorized as functionally landless if it has insufficient land to support its livelihood. The upper limit of the amount of land for identifying households as functionally landless varies between sources and countries. For example, in India households with less than 0.4 hectare are usually considered functionally landless while the usual threshold in Bangladesh is 0.2 hectare.

farming or from improved non-farming opportunities depends on the local agricultural potential and non-farm opportunities. Labour-oriented households with no or very little or poor quality land do not have the cushion of subsistence production and are typically among the poorest. The additional employment opportunities created by improved access are especially important for the landless households who form a substantial proportion of the rural population in some countries. For diversified households the scope of diversification and return to diversified activities could improve. Such households also benefit from the additional employment farming and non-farming opportunities created by improved access. The employment effects for households relying on remittances from migrant family members may be marginal.

As for rural access and feeder roads considered in section 3.4, depending on traffic and other conditions, major rural roads could either be gravel or low-cost sealed surfaces. Typically, they are also the responsibility of local authorities with central government financing any investments and maintenance through the local government ministry and local taxes and, in some cases, through national road funds. These roads will have higher priority than access and feeder roads (see section 3.4). Nevertheless, resource limitations often mean that only some of these roads, sometimes identified as the "core local network", can be preserved in reasonable condition through rehabilitation, upgrading (if justified) and maintenance. For example, in Nepal the Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR) supports each district in preparing a master plan to identify the core district network to be preserved. The remainder may be classified as major rural roads but in effect receive the same treatment as the rural access and feeder roads.

Donor and multilateral agencies may supplement investment and maintenance budgets with grants or loans at concessionary rates. In such cases, labour-based approaches may be preferred and have employment generation impacts (see section 4). As for rural access and feeder roads (section 3.4), charging users for major rural road investment is rare but local administrations typically receive allocations from the central government budget or the road fund.

Overall, because of resource constraints a strategic approach, which takes into account rural and national development priorities, is needed to identify the most important major rural roads to be constructed and maintained within the available budget. The construction and maintenance of this category of roads is likely to be particularly suited for labour-based methods. Thus, from an administrative perspective, policies, institutional changes and capacity building should ensure that the management strategy is able to effectively implement and introduce labour-based approaches.[34] The Nepal example demonstrates some of the features of a strategic approach with master plans for each district. The Government of Nepal seeks external finance to support the implementation of the master plan. The U.K. Development Fund for International Development (DFID) is one of the donors supporting such implementation in eight districts[35] through the Rural Access Programme 3 (RAP3) by putting in place and implementing a local road network asset management strategy with labour-based road rehabilitation and maintenance approach.

[34] See sections 2.2 and 2.3 above for management reforms conducive to labour-based methods, and section 4.1 for obstacles to their introduction.

[35] In addition to eight core districts, RAP3 operates in six pilot districts (RAP3, n.d.).

3.6 Interurban highways

Interurban highways serve the rural economy and more broadly productive economic activities nationally, including in urban areas. Expenditure on these roads serves the rural economy by improving: (a) connections between rural areas enabling trade and specialization; (b) links between rural areas and urban centres; and (c) the potential for exporting rural produce. These improved links increase the potential for more productive economic activities, more specifically expanding cash crops in farming and non-farm production because of the increased market potential and related services. As noted above in relation to rural roads, the benefits for the rural economy may not be manifested solely in increased employment but in more productive employment and less underemployment. Further, these improvements reduce the cost of inputs and consumer products transported into the rural areas. Apart from improvements in the transportation of goods, improved access also widens the scope for rural people seeking employment.

However, the functions of these highways are broader, encompassing transport services for the production of goods and services in urban areas and interurban and inter-regional transactions. For urban economic activities producing goods and services, lowering transport costs and expanding access through improvements in the interurban network improves margins because it lowers the cost of transporting goods and people, and offers the potential to expand the market. The consequence would be overall expansion of production and related employment. However, urban areas and regions with inherent competitive advantages such as availability of skilled labour and established businesses would gain at the expense of less competitive regions. As a consequence of labour mobility, which is enhanced by transport investment, the less developed urban areas and regions may lose out while there is a net gain in output and employment for the economy as a whole.

The traffic levels will be significantly higher than on the lower category of roads with much larger numbers of commercial transporters of goods and people, and private transport, comprising largely of urban users for leisure, and for personal and business purposes. The average journey lengths will be longer than on the lower category roads. A qualification of note is that, on the less important interurban roads, traffic volumes will be modest based on the evidence in the previous section that, on 98 per cent of roads, traffic is below 5,000 VPD.[36]

Interurban roads will typically be fully engineered sealed roads with design specifications dependent on traffic types and levels. Construction, upgrading and rehabilitation will normally be carried out using equipment-based methods with some prospect of increasing the employment content, normally more in maintenance than in construction. The executing agency will be a more or less autonomous road agency with a dedicated road fund or a department under a ministry depending on the status of reforms (see section 2.3). Under reformed new style road funds, proxy user charges such as fuel levies, will typically be the principal source of financing, but funds relying wholly or largely on proxy user charges are rare as noted in section 2.3. Where private sector funds have been sought for relatively high traffic volume roads, tolls will typically be the source of funds. Even on this category of roads regular maintenance is often given lower priority than new construction and upgrading. In many developing countries, there is heavy reliance on donor and multilateral agency grants or loans for investment in roads.

[36] Traffic volume of 5,000 VPD is in effect an average of just over 200 vehicles per hour or equivalent to between three and four vehicles per minute. If the peak traffic volume were double the average, there would be less than 10 vehicles per minute at peak times on most roads including many interurban roads.

Developing and preserving an adequate network of interurban roads is necessary for the roads sector to contribute to enhancing economic activities and related employment. However, the roads sector will not be able to fully contribute to economic development and employment creation in the absence of government policies and actions to: (a) enable and promote competition in the transport services sector; and (b) reduce the costs and regulations pertaining to transporters and road users, and how they are implemented.[37]

3.7 Summary of issues and themes

This sub-section draws together some major issues and themes from this and the previous section. There are benefits in the form of lower transport costs, and faster and better transport services for end-users. The benefits for producers, small or large businesses, and the self-employed including farmers, will lead to expanded or higher value added production of goods and services, and consequent increased or better employment. The economic and employment benefits arising from cheaper, faster and better transport for personal users are higher demand for transport, which increases output and employment in the transport services, and related sectors.

The intermediaries in delivering these improvements are the transport service providers and traders. Therefore, the balance of benefits gained by producers, personal users, traders and transport service providers and, hence, the level and type of employment generated depend on the degree to which the intermediaries capture rents. Generally, the higher the rents captured by the service providers and the intermediaries, the lower the economic and employment gains arising from improved roads.

The extent to which the benefits of lower transport costs and improved services are passed on to end-users will depend on the transport services sector market structure features, regulations and the level of barriers for new entrants. The market structure is not static and, consequently, the response of existing suppliers in a competitive market should be to expand the improved services and lower fares to attract customers. New entrants would also be attracted into the market. However, if the commercial transport services market were controlled by a few dominant players and protected by regulation, transport costs would remain high, and the incumbent transporters would capture all the rents from road expenditure.

For the lower category rural roads (farm roads, rural access and feeder roads) the issue of rent capture by service providers is less serious because of the nature of transport requirements at this level (typically, low-volume traffic in goods and people over shorter distances), and the low cost of entry for smaller and informal transport service providers operating IMTs. Indeed, the improved roads create opportunities for employment and self-employment in transport services. A dramatic change since the 1990s in many developing countries has been the rapid expansion of motorcycle taxi services. Combined with the widespread access to mobile phones, this development has made transport more accessible for economic and non-economic purposes (Porter, 2013). Nevertheless, Starkey and Hine (2014) note that, in some countries, regulations on IMTs are too tight and prevent exploitation of the full benefits they can bring. On higher level roads (major rural roads and interurban highways), the commercial transport operators are exposed to less competition, and there is evidence in a number of countries of a few dominant players

[37] See sections 3.7 and 5.3 for discussion of this issue.

restricting competition. Further, regulations and how they are implemented increase costs.[38]

Traders as buyers of farm produce and suppliers of consumer goods clearly benefit from lower costs and easier access. The extent to which they are able to capture rents from the lower transport costs will depend on the market structure and regulatory framework. For the lower category rural roads, the ability to capture rent is limited because of low-entry barriers for small local traders who also benefit from mobile telecommunications. The benefits to traders arising from the improvement of interurban highways could be captured by the larger traders protected by regulatory and other entry barriers.

Evidently, investment per unit of road required for farm roads and other rural roads (the secondary and tertiary network) is much less than that for major interurban roads (the primary network). In spite of this, the provision of resources for investment and maintenance of rural roads and other infrastructure tend to be poor because of a combination of reasons. The first is resource constraints. While unit costs of investment (cost per kilometre) are low, the total costs of investment and maintenance are substantial because of the extensive network.

It has been argued that there is an anti-rural or pro-formal economy bias in investment expenditure, which may have its roots in the political economy. The debate on this subject is complex and much of it beyond the scope of this paper (Jones and Corbridge, 2010). Nevertheless, the interaction between the urban and rural economies is crucial in the development process (Lynch, 2005). The transport infrastructure plays an important part in strengthening this interaction.[39]

If such a bias were to exist, as far as the allocation of investment in rural roads is concerned, it is reinforced by the large resource requirements and concern about the lack of sufficient institutional capacity to implement the investment and manage the network. This in turn explains the reluctance to allocate increased resources to investment in rural roads. A further aspect that adds to the reluctance to invest in rural roads and other rural infrastructure is the perceived difficulty of the technical implementation of investment in rural areas. This point is developed further in section 4.1 in relation to choice of technology, which also highlights the potential for employment generation in road investment with the appropriate technology choices. An argument against the anti-rural bias and the justification for concentrating higher infrastructure investment to support the formal urbanized economy is the benefits of strong agglomeration effects. This justification of investment is valid but not at the expense of the appropriate level of investment in rural roads.

There are three important related issues. The first applies to all levels of roads and is the need for adequate levels of maintenance to preserve the roads in states that will enable continuing benefits. The provision of maintenance would also contribute to employment creation. The second is that the full benefits of road improvement at this level need investment in the higher level road network. The third is related to the nature and density of traffic on this category of roads and the implications for the nature and level of investment required.

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[38] See section 5.3 for further discussion.

[39] See section 5.3 for examples of the importance for the rural economy, and employment of proximity and better access to urban areas.

An important qualification to the overview in this and the previous section is the necessity to exercise caution in making generalizations. For example, major rural roads and interurban highways in China and India may serve broadly similar purposes as the same category of roads in smaller countries with lower population densities. However, the population densities, types of economic activities and related employment patterns will vary significantly between the larger more populous countries and smaller countries and, as a consequence, so will the features and volumes of traffic.

Further, given the complementarity of different categories of roads in providing transport, a network approach is needed to determine the choice of road investments (to include the allocation between roads of different categories and the choice of roads), the type and level of investments and the balance between investment and maintenance. These choices have implications for the employment impacts related to roads sector expenditure, and the development and employment effects of the resulting improvements.

Our focus is limited to rural roads of different categories and interurban highways. There are higher level roads providing connections between regions within countries, and international corridors and routes connecting countries. The construction and maintenance of these roads will typically be by equipment-based methods but will have some employment impacts. Such roads also complement the rest of the network and have higher strategic importance for economic development. The issues of rent-seeking related to the market structure of the transport service sector and implementation of regulations are equally, if not, more important for these roads. In addition, for roads providing international connections, there are costs and rent-seeking related to customs regulations and their implementation.

4. Direct, indirect and induced employment effects of roads sector expenditure

4.1 International evidence

This section reviews the direct, indirect and induced effects related to roads sector expenditure and section 5 reviews the generated or developmental employment effects resulting from improved and maintained roads. As already noted (section 2), roads sector expenditure (including construction, rehabilitation and maintenance) normally ranges between 2 and 4 per cent of GDP. In African, Caribbean and Pacific (ACP) countries, roads sector expenditure is between 5 and 10 per cent of government recurrent budgets and between 10 and 20 per cent of the capital development budget.[40] The proportions are in similar ranges in other developing countries. However, the employment effects are not just confined to the labour input required in the road construction activity (direct employment). Insofar as the inputs required are supplied by the construction or other sectors in the economy, they will generate employment within the country (indirect employment). Further, additional jobs result from the spending of workers engaged in roads sector works and the sectors supplying materials and services for the roads sector works. This employment is referred to as "induced".

These direct, indirect and induced employment effects are short-term, associated with road construction and maintenance activities while the generated or developmental effects discussed in the next section are longer term. The magnitude and nature[41] of the direct, indirect and induced employment effects depend on two factors: (a) the choice of technology, in particular the mix of labour and equipment, in road construction and maintenance, and the sectors from which the inputs are purchased; and (b) the proportions of inputs into road construction (materials, services and equipment) which are produced within the country. Table 6 summarizes the factors affecting the choices and shows that there are some common factors affecting the level of direct, indirect and induced employment, and some differences.

[40] EC (2016).

[41] By 'nature' we mean the balance between unskilled and skilled labour, and professional and technical staff in the employment created.

Table 6. Features affecting the employment effects of roads sector expenditure

Type of effect	Definition	Features affecting employment (quantity and nature)
Direct	Employment in road construction, rehabilitation and maintenance.	Determining factor - Labour, equipment and materials mix in road construction and maintenance. Features affecting - Road type (interurban highways, major rural or rural access roads). - Economic and engineering considerations. - Policy influence.
Indirect	Employment in sectors supplying goods and services for road construction, rehabilitation and maintenance.	Determining factors - Proportion of equipment, materials and services for roads sector works sourced domestically. - Labour, equipment and materials mix in the sectors supplying goods and services for roads sector works. Features affecting - Economic and engineering considerations. - Policy influence.
Induced	Employment resulting from the spending of workers engaged in: (a) roads sector works; and (b) the sectors supplying materials and services for the roads sector works.	Determining factors - Proportion of domestically sourced equipment, materials and services consumed by the roads and supplying sector workers. - Labour, equipment and materials mix in the domestic sectors supplying goods and services to the roads sector. Features affecting - Economic and engineering considerations. - Policy influence.

Source: Developed by the author.

For direct employment, the economic and commercial considerations (the relative cost of labour, equipment and materials) are important. If unskilled labour were relatively cheap, in principle contractors would prefer a more labour intensive approach to minimize costs.[42] However, the feasibility of the level of labour intensity depends on the type of road and whether it is construction or maintenance. For interurban highways and other roads with higher traffic volumes requiring higher specification sealed surfaces, the unskilled labour input will be in a limited number of activities. The material and equipment costs will form a high proportion of costs. Technically skilled labour (e.g. to operate machinery, test materials and supervise) and professional staff inputs for project management and implementing to specified technical standards will be relatively high in comparison with unskilled labour, but the total labour costs will be a smaller proportion of total costs.

Economics and engineering requirements are not the only factors influencing the employment impact of road investment. Other factors are technical knowledge, preferences and policies. The technical knowledge and preferences are shaped by the education and training of engineers and accumulation of experience. The conventional training of engineers is typically equipment-based since it is adapted to higher labour costs and labour market conditions in higher income western economies. In countries with a

[42] The assumption here is of private sector contractors since this is the predominant mode. The economic argument would be equally valid for activities directly implemented by public sector agencies aiming to make the most efficient use of their resources.

cheap and abundant labour supply (often associated with a high level of landlessness) and a history of road construction and civil works adapted to these conditions, a more labour-intensive approach is likely to have been developed. In countries with no such base of experience and knowledge, the approach will generally be more equipment-intensive unless explicit efforts have been made to develop a labour-based and pro-employment approach[43] to increase the employment impact.

Policies play an important role in developing an environment in which labour-based approaches appropriate for the types of roads are adopted. The policies required are sector-specific and related to broader macroeconomic and employment issues. The sector-specific policies include support for the development and adoption of labour-based approaches, and establish institutional and incentive structures for roads sector investment. External aid and technical assistance agencies have an important role to play in supporting the development of more employment-intensive policies and programmes, where appropriate. An example of this role is DFID's financing and support of a labour-based programme in Nepal (section 3.6). EIIP provides technical assistance for policy formation, and supports institutional development and the implementation of the challenging labour-based approach for infrastructure investments, including investment in roads.

Starkey and Hine (2014) note that there is now a substantial body of evidence favouring the labour-based approach for the construction of rural roads and maintenance of all roads in developing countries. However, the labour-based agenda is often driven by pro-poor development agencies because policy-makers, engineers and contractors favour equipment-based methods. Thus, realizing policy and institutional changes poses challenges. The illustrations from Nepal and South Africa in box 5 highlight these challenges and the South African case shows how they can be addressed.

[43] The labour-based approach can be defined as a labour and light equipment combination for effective and efficient infrastructure works appropriate for the context taking account of the economic considerations and technical requirements.

Box 5. The challenges of implementing policy and institutional changes to increase the employment impacts of roads sector works

The District Roads Support Programme (DRSP) in Nepal – donor led initiatives and challenges of institutionalizing changes

The Swiss Development Cooperation (SDC) provided financial and technical support to the Government of Nepal through the DRSP to improve the rural road network in seven out of 50 districts in Nepal between 1999 and 2013 (with an extension to 2014). The cluster of seven districts is in the hilly and mountainous parts of the Central Development Region. The aims of the DRSP were to construct, rehabilitate and maintain rural roads using labour-based methods, and to target the road improvement and the resulting employment generated towards disadvantaged groups. DRSP constructed 160 km of new rural roads, and upgraded and rehabilitated 450 km of existing tracks to an all-weather standard with the focus on improving access for people in the remote areas. It generated five million person-days of employment of which half was for disadvantaged groups, including women and marginalized castes The programme also initiated a road maintenance programme and collaborated with other donor-funded programmes.

DRSP undertook training and capacity-building activities to support the Department of Local Infrastructure Development and Agricultural (DoLIDAR) and the districts in planning and implementing the rural roads construction by labour-based methods, and implemented schemes designed to increase incomes and reduce poverty. However, based on a review of the programme (Starkey at al., 2013), Starkey and Hine (2014) concluded that the DRSP and other programmes had not yet influenced policy-makers and commercial contractors who preferred machine-based operations, which are well entrenched in the current systems and practices. Commercial contractors preferred to avoid the complications of using locally recruited workers and had been known to accept contract penalties for using non-labour-based methods. Some also preferred to use teams of migrant workers to fulfil their labour requirements.

EPWP in South Africa – Employment orientation but low employment intensity and policy response

EPWP was initiated in 2004 to address the unemployment problem by providing short-term employment in public works including the construction and maintenance of roads. The programme is currently in its third phase (2014/15 to 2018/19) and has evolved to encompass training for participants and a wider range of projects (including socially-oriented development) and involvement of the voluntary sector. A review of the employment intensity of the programme's roads sector investment during Phase 2 (Gamoo and Johannessen, 2012) found that labour intensity in this sector was low (about 11 per cent). Further, pilot projects and international evidence have demonstrated the potential for increasing the employment impact.

They identified the obstacles to increasing labour intensity as a lack of a clear policy framework, objectives and targets for the use of labour-based working methods and proposed the establishment of a rural roads programme that would combine the objectives of improving the provincial roads infrastructure and creating more jobs. For this to change, Gamoo and Johannesen (2012) identified the need to reinforce the commitment to increasing the employment impact by establishing: (a) a clear policy framework and objectives with strong commitment from policy-makers; (b) a well-defined road works programme suitable for labour-intensive work methods (notably, focusing on improving access for poor rural areas and townships, with the consequent benefits of improved access in the longer term); and (c) detailed designs and methodological specifications describing the use of labour-intensive work activities in technical manuals and guidelines. The Guidelines for the implementation of labour-intensive infrastructure projects under the Expanded Public Works Programme (EPWP), third edition, 2015, integrated many of these authors' recommendations (Gamoo and Johannessen (2012).

Sources: Gamoo and Johannessen (2012); Starkey et al. (2013); Republic of South Africa. Department of Public Works (2015).

Since the policy aim is to develop an economically justifiable and sustainable approach to roads sector investment, any adjustments to the incentive structure should be to remove or adjust for the distortions that work against employment. A further policy issue is the allocation of resources within the sector between different categories of roads. Generally, there is a higher potential for generating employment for a given level of expenditure for lower category rural roads than for higher category interurban roads.

Further, the employment created in rural roads investment is targeted towards the rural areas, which typically have higher levels of underemployment and associated poverty. Nevertheless, the amount and type of employment generated cannot be the sole or even the most important factor influencing the allocation of investment resources. The development and longer term employment impacts considered in the next section are equally, if not, more important.

In order to create an environment that increases employment impact, it is necessary to introduce and adapt the labour-based approach as an option. This requires developing awareness of the availability and feasibility of the approach, and overcoming resistance through demonstration projects and examples of programmes in other countries. In the longer term, it will also require the integration of the approach into professional education and training curricula. In the shorter term, capacities need to be developed through education and training for policy-makers and implementers in both public and private sectors. Smaller local private sector contractors may be more suited to implementing rural road projects by labour-based methods. However, a proactive approach would be needed to develop their management and implementation capacities including labour-based methods, and to make the contracting and payment procedures more amenable to them so that they are more likely to bid for and undertake such works.

The indirect employment impact depends on: (a) the proportion of roads sector inputs that are sourced domestically; and (b) the employment intensities of production in the sectors that supply inputs to the roads sector. Typically, the most important sectors are producers of construction plant, equipment and tools, materials required for road building (e.g. concrete, bitumen and asphalt) and professional and technical services. The proportion of domestically sourced inputs depends on the types of road expenditure and capacities of the relevant sectors to supply the products and services competitively. For example, imported heavy equipment is needed for the construction of interurban highways, which limits the domestic employment impact, while the tools and light equipment used for more labour-intensive rural road works could be sourced domestically. Clearly, within the domestic supply sector, the technology choices and consequent employment impacts are affected by economic and technical considerations and policies.

For induced employment, there are two influences on employment impact in addition to the broader economic, technological and policy elements: (a) the proportion of domestic consumption expenditure of direct and indirect workers; and (b) the labour intensity of roads construction and sectors supplying to the sector. The former depends on the production patterns and capacities in the economy, as well as the consumption preferences and patterns of those engaged in the roads sector. Typically, there are significant differences in consumption patterns between lower income rural workers spending their incomes predominantly in the local economy consuming domestically produced food and other essential items, and higher income urban workers with higher marginal propensities to consume imported products.

In summary, labour intensity is related to the choice of technology and the sectors supplying the roads sector. The combination of these two elements has important implications for the magnitude and nature of the induced impact. For example, if rural road construction is labour-based and a high proportion of materials and other inputs are sourced within the economy, the induced employment impact influenced by the choice of technology and the consumption patterns of those employed will be higher than if equipment-based methods are used. Moreover, labour-intensive construction projects with high shares of unskilled workers have larger induced effects because rural households with

lower earnings to which they belong consume more local goods.[44] Further, the employment impact will be heavily orientated towards rural unskilled workers, and will contribute to the reduction of underemployment and unemployment, and associated poverty.

In the rest of this section, we present some evidence to illustrate and elaborate on the introduction to the nature of direct, indirect and induced employment. Social accounting matrices (SAMs), dynamic social accounting matrices (DySAMs) and input-output (I-O) tables have been adapted to estimate these employment impacts.[45] The models represent structural relationships between the sectors of an economy, notably how dependent each sector is on every other sector, both as a customer of outputs from other sectors and as a supplier of inputs. The structural relationship is complemented by an accounting framework summarizing all inter-sectoral exchanges and transactions and with the rest of the world, and employment satellite modules to quantify the employment effects of investment and changes in the value of outputs and consumption.

Table 7 shows the indicators commonly used to measure the employment impact of investment and the multipliers which represent the relationships between direct, indirect and induced employment. These indicators are used in table 8 to summarize broadly comparable evidence from a number of studies of the employment impact of roads sector investment using different technologies in selected countries. The first indicator in table 7 is the direct cost (i.e. the investment expenditure) per FTE year of direct employment (column 5 in table 8). The second indicator in table 7 is the direct cost per FTE year for all jobs (direct, indirect and induced) related to the investment expenditure (column 6 in table 8). The multipliers T1 and T2 (columns 7 and 8 respectively in table 8) representing the quantitative relationships between direct, indirect and induced employment generated by road sector expenditure are estimated from the DySAM and I-O models.

Table 7. Direct, indirect and induced employment generated by investment

Indicators and multipliers	*Definitions*
1. Direct cost per FTE year of employment (US$) - direct employment only	*Total cost (US$) / Direct employment (FTE years)*
2. Direct cost per FTE year of employment (US$) – direct, indirect and induced	*Total cost (US$) / Direct+Indirect+Induced employment (FTE years)*
3. T1 Multiplier	*(Direct+Indirect employment) / Direct employment*
4. T2 Multiplier	*(Direct+Indirect+Induced employment) / Direct employment*

The country contexts, differences in the level of development, labour market conditions and regional characteristics all affect the employment impacts, as table 8 and the following discussion show. In some cases, notably, in MENA countries, evidence from studies of direct employment generated from actual projects or programmes combined with augmented I-O models is used to estimate the employment impact. In all other cases, augmented I-O models are used but the estimates are based on hypothetical levels of roads sector expenditure. The term “Simulation” in table 8 indicates that the employment impact

[44] Van Imschoot and Brudefors (2015, p. 30).

[45] See Ernst et al. (2015) for more details on these methods.

is not taken from an actual infrastructure investment. For comparison, where the levels of expenditure are specified in national currencies, they have been converted to current nominal US dollars.[46]

The major differences in labour market contexts between countries at different levels of development are relevant when considering the employment impacts of roads sector expenditures. This it is because one of the aims is to examine whether the employment outcomes (magnitudes of the employment impacts and their nature) of investment decisions are congruent with a country's labour market context and employment priorities. This paper's focus is on developing countries where the term "developing countries" refers broadly to the World Bank's LIC and LMIC classification of countries as explained in section 1. Table 8 includes evidence from one LIC, three LMICs, two upper middle-income countries (UMICs) and two HICs for comparison.

More specific implications for employment impact of differences in labour market features between countries at different levels of development are discussed with reference to table 8. Here we note some general labour market characteristics at different leves of development. A high proportion of the labour force in developing countries is engaged in the informal economy, either employed in small informal sector enterprises or in self-employment (including farming) and unpaid family workers. Although employment in agriculture is declining, between 22 and 50 per cent of workers in LICs are employed in agriculture (Cho et al., 2012). The scarcity of sufficiently productive employment means many of them have to rely on a range of mostly informal livelihood sources. As a consequence, "the majority of workers in the world today are in the informal economy, and the majority of the new entrants to the global labour market enter the informal economy" (Campbell and Ahmed, 2012, p. 6). Furthermore, the incidence of poverty is strongly associated with rural informal workers because their livelihoods are more often exposed to income shocks and they lack access to adequate social protection. Clearly, the incidence of informality and reliance on low productivity farming is less in LMICs and UMICs than in LICs, but the numbers are still substantial. Typically, LMICs and UMICs have higher incidences of youth unemployment.

In LMICs and LICs with slow economic growth, the challenge of providing jobs for a young workforce results in high youth unemployment rates (Campbell and Ahmed, 2012). High women's unemployment and low labour participation rates are also a major problem and are, in part, a reflection of the general shortage of employment opportunities. However, in some countries, they are also related to cultural barriers restricting women's employment opportunities. These challenges are likely to get more serious with large numbers of new labour market entrants in the foreseeable future. Campbell and Ahmed estimated that about 200 million new entrants would enter the labour markets in developing countries in the next five years (Campbell and Ahmed, 2012).

For the two HICs[47] in table 8, the studies were conducted in the context of the need for a fiscal stimulus in the aftermath of the 2008/9 global financial crisis. When compared with employment impacts in the other countries in the table, the impacts measured by the number of fulltime equivalent (FTE) years of jobs created are low in these two countries and correspondingly the cost per job created is high. This is to be expected since labour costs are significantly higher in these two countries corresponding with the higher GNI per capita.

[46] For example, the exchange rate when the study was undertaken.

[47] Ireland and the United States.

For the United States, we have an estimate of 19 total direct, indirect and induced jobs (FTE years) per US$1 million of expenditure, but the evidence does not permit separation into direct, indirect and induced jobs. An important qualification applying to the number of direct, indirect and induced jobs per unit of expenditure, and the cost per job created in all the cases in the table, is that it understates the cost of creating employment. This is because only the costs of infrastructure investment are included. The costs of generating the jobs in the sectors in which indirect and induced jobs are created are not included.

For Ireland, the separation between direct, indirect and induced jobs is possible with the help of the multipliers. Of the total 13 FTEs per US$1 million of expenditure, 8.2 are direct, 3.1 indirect and 1.7 induced. The comparison between road construction and improvement indicates that improvement is somewhat more labour-intensive than construction.[48] The total number of FTEs per US$1 million is higher for the United States than for Ireland. If strictly comparable[49] possible explanations are higher employment intensity and higher proportion of inputs being domestically sourced in the United States.

The term "Conventional" in the technology column of table 8 implies the use of equipment for construction activities with labour representing technical staff and equipment operators for peripheral activities that cannot be performed by the equipment. Typically, labour costs are about 10–12 per cent of the total costs as Maniscalo et al. (2011) shows (see table 9). However, the term is not very precise since the combination of equipment and labour can vary substantially between countries, as the discussion below and table 9 indicate.

The next set of entries in table relates to MENA countries. They include rural roads (Morocco) as well as highways with the number of jobs created ranging between 46 and 76 per US$1 million. Information on labour intensity is available for these investments from micro-level studies showing labour intensities of 12, 14 and 26 per cent for the projects in Morocco, Tunisia and Jordan, respectively. The labour intensities being in reverse order to the number of jobs created per US$1 million appears to be counter-intuitive. However, comparison of the T1 and T2 multipliers between the three countries shows that the low cost per job created on Programme National des Routes Rurales (PNRR) 2 in Morocco in spite of the low labour intensity is because of the higher T1 and T2 multipliers. The relatively high labour intensity on the Jordan project using the conventional approach is because of the higher wage rates in Jordan. Labour intensity is an expenditure measure, which is a product of the amount of employment and the cost of employment. Hence, when the labour cost is high the number of jobs created per unit of expenditure will be lower.[50]

The employment impacts of simulated expenditure in Gujarat and West Bengal States in India (Sinha et al., 2015) are of a different order of magnitude from those in Ireland, the United States and MENA countries. It is also striking that while the number of FTE jobs created is higher for labour-based rural roads than for highways constructed by conventional methods, the FTE jobs created under the latter are still very high in comparison with the other cases in the table. Evidently, the conventional method in India

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[48] Calculations based on the multipliers indicate that the numbers of direct and induced jobs in improvement are higher but those in indirect are lower.

[49] This is an important qualification when making this comparison and others based on table 8 since the methodologies differ. The comparisons should, therefore, be made on a broad order of magnitude.

[50] The micro study of the project in Jordan indicates that manual work is considered to be undesirable by Jordanian citizens, and a large proportion of the skilled and unskilled workers on the project were foreigners.

is more labour-intensive than in the other countries. This combined with the much lower wage rates for skilled and unskilled labour leads to the much higher generation of employment for US$1 million and correspondingly much lower costs per job in India.

The lower level of materials and equipment required for labour-based methods in India explains the smaller T1 multipliers for rural roads construction. However, the much higher T2 multipliers for highways are counter-intuitive. A possible explanation is higher incomes and marginal propensities to consume for workers in highway construction than in rural roads. The higher impacts in West Bengal imply higher labour intensities and higher wages leading to higher consumption impacts. The study makes a distinction between formal and informal sector jobs and finds that the jobs created are predominantly in the informal sector. This is related to features of the Indian labour market; high levels of landlessness mean the landless rely on wage income from informal employment for their livelihoods.[51] In table 8, reference is made to highway construction technology being conventional for India but with higher labour intensity than elsewhere. The high use of informal labour and labour intensity in the construction sector in India is explained by the low cost of labour (skilled and unskilled), and based on the practice of using a more labour-intensive approach in this sector.

The employment impact for Indonesia (Ernst and Chatani, 2011) falls in between the HIC and MENA studies on the one hand and the Indian study (Sinha et al., 2015) on the other to provide the number of jobs created for a given investment. Broadly speaking, when compared with India, the lower labour intensity in Indonesia can be explained by higher labour costs. If GDP per head is used as a proxy for labour costs and wage rates, the GDP per head in Indonesia at more than twice that in India (about US$3,400 in Indonesia compared with about US$1,500 in India) indicates much higher labour costs in Indonesia. The higher job creation of conventional and labour-based investments in Indonesia than in HICs can be explained by the much lower labour costs in Indonesia (using GDP as a proxy). The same explanation does not apply when comparing Indonesia with MENA countries because of differences in labour market conditions and priorities, which are discussed below. The employment impacts in the Liberia study fall between those for India and Indonesia. Further, there are marked differences in the employment created between the labour-based and equipment-based approaches.

[51] See discussion below on differences in labour market conditions between countries.

Table 8. Roads sector investment employment impact comparison for selected countries

(1) Country	(2) Global region	(3) Project / programme	(4) Technology/ approach	(5) Direct cost per FTE year job created (direct jobs only) (US$)	(6) Direct cost per FTE year job created (direct, indirect and induced jobs) (US$)	(7) Total FTE year jobs per US$1 million of investment	(8) T1 multiplier [direct + indirect jobs]/ direct jobs	(9) T2 multiplier [direct + indirect + induced jobs]/ direct jobs	(10) Sources (year of data)
USA	HIC (OECD)	Simulation – roads (investment)	Conventional	–	52 632	19	–	–	Miller, 2013 (various)
Ireland	HIC (OECD)	Simulation – roads (construction)	Conventional	124 245	77 952	13	1.38	1.59	National Roads Authority, 2013 (2009)
Ireland	HIC (OECD)	Simulation – roads (improvements)	Conventional	106 165	71 971	14	1.28	1.48	National Roads Authority, 2013 (2009)
Morocco	MENA (LMIC)	Programme National des Routes Rurales – PNRR 2	Conventional	50 282	13 124	76	2.58	3.83	Van Imschoot and Brudefors, 2015 (2003–2012)
Tunisia	MENA (UMIC)	Priority roads	Conventional	29 136	18 506	54	1.34	1.57	Van Imschoot and Brudefors, 2015 (2011)
Jordan	MENA (UMIC)	Amman ring road	Conventional	58 516	21 651	46	1.87	2.67	Van Imschoot and Brudefors, 2015 (2010)
India (Gujarat)	South Asia (LMIC)	Simulation – highways/urban roads	Conventional (for India)	3 716	491	2 035	1.80	3.38	Sinha et al., 2015 (2009–2010)
India (Gujarat)	South Asia (LMIC)	Simulation – rural roads	Labour-based	663	300	3 335	1.18	2.21	Sinha et al., 2015 (2009–2010)
India (West Bengal)	South Asia (LMIC)	Simulation – highways/urban roads	Conventional (for India)	2 155	239	4 182	1.98	5.30	Sinha et al., 2015 (2009–2010)
India (West Bengal)	South Asia (LMIC)	Simulation – rural roads	Labour-based	690	197	5 089	1.31	3.51	Sinha et al., 2015 (2009–2010)

(1) Country	(2) Global region	(3) Project / programme	(4) Technology/ approach	(5) Direct cost per FTE year job created (direct jobs only) (US$)	(6) Direct cost per FTE year job created (direct, indirect and induced jobs) (US$)	(7) Total FTE year jobs per US$1 million of investment	(8) T1 multiplier [direct + indirect jobs]/ direct jobs	(9) T2 multiplier [direct + indirect + induced jobs]/ direct jobs	(10) Sources (year of data)
Indonesia	South East Asia (LMIC)	Simulation – construction: roads	Labour-based	–	2 246	445	–	–	Ernst and Chatani, 2011 (2000-2008)
Indonesia	South East Asia (LMIC)	Simulation – construction: roads	Conventional	–	4 713	212	–	–	Ernst and Chatani, 2011 (2000–2008)
Liberia	Sub-Saharan Africa (LIC)	Simulation – employment-intensive approach to infrastructure	Labour-based	–	710	1 408	–	–	Maniscalo et al., 2011 (2008)
Liberia	Sub-Saharan Africa (LIC)	Simulation – conventional approach to infrastructure	Conventional	–	1 119	893	–	–	Maniscalo et al., 2011 (2008)
Maximum				124 245	77 952	5 089	2.6	5.3	
Minimum				663	197	13	1.2	1.5	
Unweighted mean				41 730	18 989	1 273	1.6	2.8	

- = Data not available.

Source: Collated by author from publications cited in column 10 of the table.

Table 9. International comparison of employment-intensive and conventional road construction approaches

Country:	Ethiopia	Uganda	RSA[1]	Lesotho	Zimbabwe	Mozambique	Nicaragua	Cambodia	Kenya	Mean
Approach:	EIA[2]	EIA	EIA	EIA	EIA	EIA	EIA	EIA	EIA	–
Cost categories										
Labour – unskilled	21	–	45	–	–	18	47	37	39	–
Labour – skilled	24	–	9	–	–	6	4	12	11	–
Labour	45	49.8	54	44	43	24	51	49	50	**45.5**
Equipment	31	23	17	–	–	34	21	12	30	**24.0**
Materials	18	14.4	29	–	–	3	23	32	11	**18.6**
Land	–	1.3	–	–	–	–	–	–	–	–
Overhead	–	7.4	–	–	–	7	–	–	–	–
Supervision	–	4.2	–	–	–	9	–	–	–	–
Miscellaneous	6	–	–	–	–	22	5	7	9	–
Other	6	12.9	–	–	–	38	5	7	9	–
Approach:	Conv.[3]	Conv.	Conv.	Conv.	Conv.	Conv.	Conv.	Conv.	Conv.	**Mean**
Cost categories										
Labour – unskilled	5		12	–	–	2	–	2	–	–
Labour – skilled	17		10	–	–	2	3	9	–	–
Labour	22	5.4	22	6	13	4	3	11	–	**10.8**
Equipment	58	59.8	49	–	–	64	69	70	–	**61.6**
Materials	15	5.4	29	–	–	2	23	19	–	**15.6**
Land	–	0	–	–	–	–	–	–	–	–
Overhead	–	12	–	–	–	7	–	–	–	–
Supervision	–	17.4	–	–	–	1	–	–	–	–
Miscellaneous	5	–	–	–	–	22	2	–	–	–
Other	5	29.4	–	–	–	30	2	–	–	–

1 Republic of South Africa. 2 Employment-intensive approach. 3 Conventional approach.

– Data not available.

Note: Figures in bold font represent the main cost categories to show the total labour cost share in relation to the other main cost categories (equipment, materials and the rest aggregated under the "other" category).

Source: Maniscalo et al. (2011).

In summary, the table shows higher job creation per unit of road expenditure in the countries representing Africa, South Asia and South-East Asia although there are substantial differences in the employment impacts between countries which can be explained by the economics (the relative costs of labour and equipment which depends on labour market conditions), established practices and any initiatives to change established practices. While the labour market context is country specific, countries can be plac ed in groups with broadly similar characteristics as illustrated below:

- MENA countries generally fall within the low middle-income or high middle-income categories. They have smaller rural populations and higher urbanization than most other developing countries. Features of rural underemployment and unemployment are similar to those in other developing countries but they are possibly less acute and smaller in scale than elsewhere. The more serious challenges are unemployment among the educated, and skilled and unskilled urban populations, notably youth and women.
- Liberia represents low income sub-Saharan Africa with a large rural labour force, unskilled or with low levels of education and skills, primarily engaged in rural economic activities. Underemployment with high seasonality and low productivity employment are more serious problems than unemployment in rural areas. Hence, employment-intensive rural infrastructure investment has an important role to play in supplementing rural livelihoods and improving the infrastructure. But there is also a growing problem of urban unemployment with more unskilled youth moving to urban areas and growing unemployment among skilled and educated youth, and the need for urban infrastructure investment, which contributes to employment generation.
- India, representing South Asia, has a high rural population reliant on informal employment and a high incidence of landlessness, both associated with low wages and earnings, and with a high incidence of poverty. In urban areas, the labour market features are similar to MENA, that is unemployment and underemployment of skilled and educated youth.

  The transport infrastructure provision is better in India than in sub-Saharan Africa, partly because of private sector investment supplementing substantial government expenditure for highways and for rural roads because of the government's commitment to improving rural connectivity.
- Indonesia represents South-East Asia with unemployment, underemployment and poverty associated with rural livelihoods, poor access and remoteness but less acute than in sub-Saharan Africa and South Asia. Higher economic growth rates over time have led to greater rural to urban mobility. Consequences are less acute rural – urban and formal – informal sector gaps and less serious urban youth and female unemployment challenges than in sub-Saharan Africa and South Asia. Infrastructure provision is generally higher than in sub-Saharan Africa and South Asia, but there is still potential for infrastructure improvement and preservation, and related employment generation.

4.2 A simulation to estimate the potential for increasing employment impact

The evidence on employment multipliers can be used to estimate employment impacts and the effects of increasing the employment impact by increasing the labour intensity of roads sector expenditure. For South Africa, Gamoo and Johannessen (2012) estimate the potential for increasing the labour intensity for construction and rehabilitation of rural gravel roads to be in the 30–45 per cent range and for bitumen surfaced provincial roads in the 20–35 per cent range. They put the potential labour intensity of maintenance in the 70–90 per cent range. The international comparison of the relative labour, equipment and other costs of rural roads construction carried out by Maniscalo et al. (2011) shows an average for the countries of just under 46 per cent for the employment-intensive approach and almost 11 per cent for the conventional equipment-based approach (see table 9).

A spreadsheet-based model has been developed to explore scenarios for the specific context of a country. Table 10 shows a simulation of alternative scenarios for a hypothetical LIC with typical levels of total government expenditure and allocation for the roads sector. The assumptions are:

- Half of the roads sector budget for investment in interurban highways, 20 per cent for rural roads and 30 per cent for maintenance of the whole network. The split between construction and maintenance assumed for this illustration is consistent with the finding by Gwilliam et al. (2011) that the typical budget split in developing countries is two-thirds construction, one-third maintenance.
- The same employment intensity on interurban highways under conventional and employment-intensive approaches.
- Introduction of an employment-intensive approach for rural roads construction and rehabilitation could potentially increase labour intensity from about 10 per cent to 45 per cent (based on the international comparison in table 9).
- Introduction of an employment-intensive approach for maintenance of all roads (potential for increasing labour intensity to 75 per cent based on international evidence).
- The values of the T1 and T2 multipliers are broadly based on the unweighted averages from the studies cited in table 8. T1 in table 10 is 1.5 (unweighted average in table 8 is 1.6) and T2 in table 10 is 2.5 (unweighted average in table 8 is 2.8).

Table 10 shows that with conventional equipment-based roads sector investment and maintenance (10 per cent labour intensity) and 2 per cent of GDP (10 per cent of government expenditure) spending in the roads sector supports just under 110,000 FTE jobs (just under 0.4 per cent of the economically active). Under the employment-intensive scenario (increased employment intensity of rural roads construction and maintenance of all roads by appropriate employment intensive methods) the employment intensity of the roads sector would increase from 10 per cent to 36.5 per cent. The employment outcome would support just under 600,000 FTE years of jobs. Further, a higher proportion of the additional jobs would be in rural areas where the incidence of poverty associated with low productivity, informal economic activities and underemployment is typically higher.

Table 10. Roads sector expenditure and employment impact: Alternative scenarios[1]

			Assumptions	Comments
Population (million)	50	50	–	–
Economically active population (million)	30	30	60	% of population
GDP (US$ eqv.[2])	62 500 000 000	–	–	–
GDP per capita (US$ eqv.)	1 250	–	–	–
Government expenditure (US$ eqv.)	12 500 000 000		20	% of GDP
Roads sector scenarios	Scenario 1	Scenario 2	Assumptions	Comments
Technology/approach	Conventional	Employment-intensive	–	–
Roads sector expenditure (US$ eqv.)	1 250 000 000	1 250 000 000	10	% of government expenditure
Interurban highways – construction expenditure (% of total)	50	50	–	Depends on the national situation
Interurban highways expenditure – share of labour (%)	10	10	–	Assumption based on international evidence
Rural roads – construction expenditure (% of total)	20	20	–	Depends on the national situation
Rural roads expenditure – share of labour (%)	10	45	–	Assumption based on international evidence
Maintenance expenditure (% of total)	30	30	–	Depends in the national situation
Maintenance expenditure – share of labour (%)	10	75	–	Assumption based on international evidence
Labour share of expenditure (%)	10	36.5	–	Calculated from the assumed shares of roads sector expenditure and labour shares
Wage rate (US$ eqv.)	12	8	–	Lower average wage rate for scenario 2 because of higher proportion of unskilled labour – depends on the national situation.
Multiplier T1	1.5	1.5	–	Depends on the national situation.
Multiplier T2	2.5	2.5	–	Depends on the national situation.
Total wage bill (US$ eqv.)	125 000 000	456 250 000	–	–
Total person days	10 416 667	57 031 250	–	–
Person days per year			240	Depends on the national situation.
Total person years (direct)	43 403	237 630	–	–
Total person years (direct and indirect)	65 104	356 445	–	–
Total person years (direct, indirect and induced)	108 507	594 076	–	–
% of labour force	0.36	1.98	–	–

Notes::1. Grey-shaded cells denote assumptions – changes can be made in the Excel based model to reflect specific country situations or alternative scenarios. 2. eqv. = equivalent..
Source: Developed by the author.

The table in Excel format has been made available by the author to explore alternative scenarios or the specific situation of a country. The grey-shaded cells include the assumptions that could be modified to examine alternative situations. For example, if public sector expenditure were 22 per cent of GDP, roads sector expenditure 12 per cent of the public sector expenditure, and the labour intensity of rural roads construction and rehabilitation, and roads maintenance were 50 per cent and 80 per cent, respectively, the employment impact would go up from just under 0.5 per cent of the labour force under the conventional scenario to nearly 2.8 per cent of the labour force under the employment-intensive scenario.

In addition, there are qualitative effects of labour-intensive investment programmes. Carswell and De Neve (2014) found that the labour-intensive Mahatma Ghandi National Rural Employment Guarantee Scheme (MGNREGS) offering an entitlement to a specified number of days of employment in public works in Tamil Nadu, India, produced significant transformative outcomes for the rural working poor, such as pushing up low rural wage levels, and strengthening the position of women and low-caste workers in the labour market. The DRSP in Nepal discussed in section 4.1 provides evidence of targeting disadvantaged groups in providing employment.

While simulations with plausible numbers can indicate what can be achieved, in practice the challenge of increasing the employment impact are at the policy, institutional and implementation levels with a need to: (a) formulate clear policy objectives with a commitment to achieve them; (b) develop management and technical capacity necessary to implement policies and programmes: and (c) change the institutional and incentive structures to enable implementation.

5. Generated employment effects of roads sector expenditure

5.1 Introduction

Three premises underlying this section of the paper are that: (a) an inadequate transport infrastructure, of which roads are a major component, is a major hindrance to economic development and growth; (b) improving the transport infrastructure is a necessary but not sufficient condition for economic development; and (c) economic development generally increases and improves the quality of employment. For most developing countries the economic growth process requires some combination of: (a) making more productive use of existing resources; (b) shifting resources from less productive to more productive sectors; and (c) using more resources to generate growth and development. Since labour is a key economic resource and the return from using own labour or supplying labour are the principal means by which most households sustain themselves, employment (to include self-employment) is the dominant transmission mechanism through which economic growth and development improve livelihoods. All three processes identified above, through which economic development takes place have employment impacts. The effects of each process are elaborated in table 11.

Table 11. Types of employment effects related to benefits generated from improved roads

Types of effects	Indicators *(and impacts of improved roads)*
1. More productive use of existing human and other resources	(a) Higher productivity *(lower cost of transport improving access to markets and reducing input costs leading to more productive use of resources).*
	(b) Higher wages indicating higher productivity but also greater labour scarcity *(improved productivity and additional employment opportunities locally and further afield).*
	(c) Higher earnings from self-employment, including in the informal sector and farming *(because of lower costs of inputs, higher prices of products and services, increased and diversified production).*
2. Shifting human and other resources from less productive to more productive sectors	Typically from low productivity farming and other informal sectors (incidence of underemployment) to more productive informal or formal sector activities *(lower cost of transport improving access to additional local and farther employment and self-employment).*
3. Productive sectors using more human and other resources	Increased employment and reduced unemployment *(increased production requiring more workers because of improved access to markets and lower costs).*

Source: Developed by the author.

Further, as for roads sector expenditure, the impacts can be categorized as direct, indirect and induced. In box 6, the direct and indirect impacts are related to development in the transport sector while the induced effects represent economic and employment growth in the rest of the economy. It is important to note that while the terms used (direct, indirect and induced) for the impacts of improved roads are the same as those for roads sector expenditure, the nature of the impacts differ in important ways with implications for the methodology for estimating them. Therefore, to distinguish from the impacts of expenditure, we refer to generated direct, indirect and induced effects and elaborate on the differences below.

The direct employment impact of roads sector expenditure is related to the magnitude of the expenditure and the proportion of labour input that directly affects employment. The generated direct impact is the outcome in the form of higher capacity roads and the lower costs of using them, which in turn increases the demand and supply of transport services. Hence, the economic and employment impacts are not in the roads sector but in the transport service sector for which the roads sector provides a service. The generated indirect impacts are essentially "derived demands"[52] related to the expansion of the transport service sector.

Box 6. Generated direct, indirect and induced impacts of improved roads: Economic and employment

- Generated direct impacts: Increased level of transport sector activity and related expansion of capacity and lower costs leading to higher added value and employment. In effect, this refers to increased output and employment of transport service providers.

- Generated indirect impacts: Increased value added and employment in companies supplying the transport sector and related firms (e.g. fuel, equipment and parts, maintenance and repair services, insurance and other business services). The expansion or new development of roadside enterprises for serving transporters and other road users could also be placed in this category.

- Generated induced impacts: Increased productive activities in sectors that benefit from lower transport costs and improved services. These are wide ranging since virtually all economic activities require transport for moving inputs, products and/or people. The impact is through reduced costs and improved quality of transport. There are further beneficial interdependencies because the products of some sectors are inputs into other sectors. The effects are not one-off but grow over time as long as the infrastructure is preserved in good condition.* All the benefits will not be realised immediately after a road improvement investment since some economic decisions to benefit from the improvements may not follow immediately and the outcomes of the decisions then take time to materialize.

* Arguably, there may be positive residual effects, i.e. road improvements provide benefits and developments that are not all lost if the roads become wasting assets because of lack of maintenance.

Source: Adapted from Rodrigue and Notteboom (n.d.).

The generated induced impacts on all other sectors of the economy of the improved roads resulting from improved and lower transport costs depend on the economic responses of these sectors to the improved roads. This is different from the induced impact of roads sector expenditure deriving purely from workers increased consumption expenditure in the relevant sectors. An assessment of the generated impacts poses methodological challenges. The DySAM and I-O models for estimating the impacts of expenditure cannot be readily used to measure these generated impacts because changes in supply conditions and economic responses to them cannot be readily accommodated in them.

It is worth highlighting two further major challenges associated with assessing the nature and magnitude of the economic, and in particular, employment impacts of improved roads. As noted above, employment (to include self-employment) is the dominant transmission mechanism through which the impacts of improved roads lead to economic growth and improved livelihoods. The first challenge is that relatively few studies address generated employment impacts per se. This is not surprising since the studies tend to focus either on the economic impacts and benefits or on the poverty alleviation effects, the latter especially for studies of the rural transport infrastructure. As a consequence, employment impacts, if assessed, are by-products of studies or have to be inferred from other impacts.

[52] The term "derived demand" refers to the demand created in the sectors supplying to the sector in which the initial demand is created.

We address this challenge in section 5.2 by reviewing: (a) theoretical constructs and evidence at the macro level on the impact of the roads sector and other infrastructure on the economy and employment, with inferences and estimates on the employment impacts, where necessary; and (b) evidence from two project and programme level studies which include the assessment of employment impacts.

The second challenge is associated with assessing rural economy employment impacts where they cannot be readily translated into a conveniently measurable unit of employment created. In informal sector farming, the lower costs of inputs and higher prices for products resulting from road improvement may not create new jobs but may reduce underemployment and increase earnings. For example, a household member shifting from low productivity farming to more productive employment would improve the livelihood of a household but may not increase the number of jobs. On the other hand, an unemployed youth obtaining a job would be a new job created. Hence, in assessing the generated employment impact, there is a need to assess the change in quality of jobs as well as quantity that cannot be captured simply by using an indicator such as FTE years of jobs created.

It is important to identify the specific context and the alternative mechanisms for understanding the nature of the employment impact because changes may be different in different contexts, and yet, in both cases, the employment-related impact might be positive. For example, improved roads may reduce farm employment in one case, and increase it in another. The former case could be due to better off-farm employment opportunities, while the latter could be due to farming becoming sufficiently productive to employ more people. In both cases, the employment related impact is positive since workers either move to better paid work or more workers are employed. The next section examines some evidence.

Given the range of different types and levels of effects, a range of methodologies has been used for evaluating the employment effects of roads sector investment and other public works. These include:

- Macro-level econometric studies to identify the variables and mechanisms explaining employment effects (including some novel approaches incorporating evidence on changes in luminosity in settlements from satellite imagery to substitute for local economic data which are not available).
- Micro-level econometric studies to examine the impact of improved roads on the economic and employment situation of households.
- Qualitative and/or quantitative impact evaluations, which could be comparisons of: (a) baselines with post-investment situations; or (b) the situations with roads sector interventions and control.
- Analysis of evidence from household surveys (economic activity and household income and expenditure) from available surveys or dedicated studies.

While this paper does not consider the technical aspects of the methodologies in detail, it will consider them from the perspective of the robustness of the findings for reaching conclusions on employment effects. In particular, the extent to which they take account of the counter-factual (i.e. comparison between with and without investment or policy change situations), and the opportunity cost of the investment (i.e. the benefits from the alternative use of resources). Adverse effects, such as possible market disruptions and losers from investments also need to be considered.

5.2 Evidence on roads investment, economic growth and employment

5.2.1 Macro level studies: Theoretical construct and employment impacts

The idea that there should be a positive relationship between infrastructure (of which roads are an important part) defined as the physical networks and economic growth is supported by economic theory and empirical evidence. The early neoclassical theories of economic growth (e.g. Solow, 1956) treated infrastructure as any other input into a stylized, economy-wide production function and hypothesized that the growth impact of any infrastructure expansion would be temporary and subject to the same diminishing returns as other factors of pr oduction.

Later endogenous growth models predict that the accumulation of infrastructure assets can increase the long-run rate of growth (for example, Barro, 1990; King and Rebelo, 1990; Barro and Sala-i-Martin, 1995). These permanently increase the return to other factors of production, implying that the increase in the stock of infrastructure enables more productive use of other resources and inputs as indicated in section 5.1 to generate higher growth. Two surveys of empirical literature (World Bank, 2007; Straub, 2008) concluded that the majority of studies covering a range of countries found a positive relationship between the stock of infrastructure assets and the rate of economic growth, with the strongest growth impacts coming from telecommunications, roads and electricity networks (Calderón and Servén, 2004; Canning and Pedroni, 2004). The focus here is on roads which are considered to be the most important component of physical infrastructure based on the magnitude of investment and their impact in improving the physical movement of resources, products and people.

A significant contribution of the macro-level endogenous growth model based studies[53] is to counter the argument that infrastructure investment, including in roads, would always compete with private sector productive investment and may crowd it out. At the macro level, there is a strong basis for the crowding in case because roads sector expenditure lowers private sector costs and improves productivity. For example, lower repairs and replacement costs for transport operators, increased and more profitable transport operations, better and lower cost services for workers as end-users, and the longer term effects of better access to health and education (Agenor and Moreno-Dodson, 2006; Estache and Fay, 2009). Bahal et al. (2015) conducted an econometric study of the relationship between public-capital accumulation and private investment in India between 1950 and 2012. They found that, over the whole period, there was evidence of crowding out, but post-1980, public investment had become complementary to private investment implying a crowding-in effect. The most likely explanation for the change offered by the authors was policy reforms, which started in the early 1980s and gained momentum after 1991. It can be concluded that judicious infrastructure investments in a conducive policy context complement private sector investment and contribute to economic and employment growth.

Nevertheless, questions remain on which roads sector investments contribute to economic development, growth and improved employment, and by how much. Not all roads sector investments augment the long-term rate of economic growth and the cause

[53] By macro-level studies, we mean those estimating effects of the infrastructure on the economy and employment at the national level, either using data for a single country or for multiple countries.

and effect relationship between roads sector investment and economic development and growth is complex and different in different contexts. Roads sector investment can contribute to economic growth but such growth also increases consumer demand for more and improved roads. Hence, whether roads sector investment enables economic growth and increases employment or whether it meets increased demand following growth, is difficult to decipher.

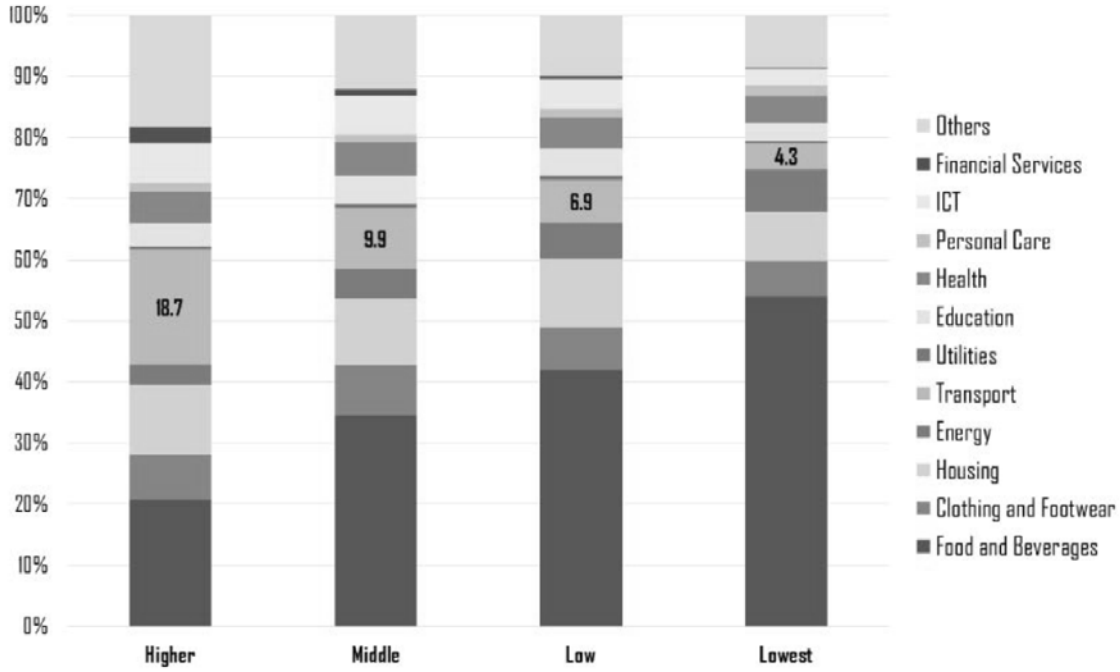
Based on a review of studies, Estache and Garsous (2012a; 2012b) provide general guidelines on the contexts in which roads sector investment is oriented towards generating economic growth and employment, and where it follows increased demand. Where there are roads infrastructure deficits in quality and quantity, as in most developing countries and especially in a number of countries in sub-Saharan Africa (see section 2), suitably chosen roads sector investments potentially enable and stimulate economic growth. Usually, in HICs, the infrastructure constraint on economic growth is less severe. Hence, economic growth tends to create consumer demand for transport, and drive transport sector investment.

Even in developing countries, consumer spending on transport is a much higher proportion of the total expenditure of richer households. If transport infrastructure investment is weighted towards meeting consumer demand for transport of the better off as represented by the level of expenditure in figure 4 (Rodrigue, 2017), it may have similarities with the characterization referred to above of economic consumer demand driven transport sector investment (Estache and Garsous, 2012a; 2012b). The higher concentration of poorer (lower income quartile) households in rural areas and the associated low demand for transport possibly reinforces the anti-rural bias in roads sector expenditure referred to in section 3.7. A consequence is lower expenditure on roads serving rural areas where the lack of access is a more serious hindrance to economic development, and related increased and better employment.

Figure 4 shows that for households in the lowest income quartile, just over 4 per cent of their spending is on transport. The share of expenditure on transport is progressively higher in the higher quartiles. For households in the top quartile, it is 18.7 per cent of household expenditure, over four times higher than for the bottom quartile. In the top quartile, transportation becomes the second most important expense, closely behind food. Explanations of the higher share of transport expense at higher income levels are ownership of motorized vehicles, and increased travelling related to social and personal uses, and formal and regular forms of employment which are pre-dominantly non-rural.

At one level this evidence simply indicates that a large proportion of the limited incomes of poor households are spent on the basic necessities of food, clothing and shelter leaving limited amounts for other categories including transport. However, a large proportion of poor households are rural and engaged in the informal economy. For them, the low transport expenditure is indicative of their lack of mobility. Further, their spending on transport as a consumer activity cannot be readily separated from transport as an input essential for economic purposes.

Figure 4. Consumption pattern by income in developing countries, 2010



Source: Rodrigue (2017) based on data from http://datatopics.worldbank.org/consumption/.

There are two related issues with the macro-level studies of estimates of the effects of the roads infrastructure on the economy. Measures and sources of data vary but commonly used measures are the value or quantity of the stock of infrastructure assets. Many of the studies use the stock of paved roads as a measure of the stock of infrastructure, partly, because they represent better quality roads considered more important for development and, partly, because data on the rest of the road network, especially for international comparability, are unreliable. The first issue is that the asset management approach does not focus on increasing the stock of road assets but on preserving a sustainable stock of roads in a sound condition to provide improved transport services, compatible with the available resources. The second is that, in the rural economy, the evidence[54] points to benefits associated with providing basic access and connectivity rather than higher quality paved roads. Hence, inclusion of non-paved or lower specification paved roads[55] that largely serve rural areas is important.

There are now a large number of studies of the impact of infrastructure on the economy covering different numbers and categories of countries. Their results vary widely because of differences in the country coverage, the data, and how and how effectively they deal with the technical issues.[56] Since our aim is not to survey the evidence but to provide

[54] See section 2.2 (evidence on China), section 3.3 and further discussion of evidence in section 5.3.

[55] Low-volume roads and tracks in rural areas are typically unpaved (earth or gravel). Because of low volumes, the improvement of unpaved surfaces is usually recommended. However, there are more durable lower specification paved options such as cobblestones, water-bound macadam and Ottaseal (see Cook et al., 2013, for more details).

[56] See Melo et al. (2013) for a recent review and meta-analysis of transport infrastructure studies.

an assessment of the likely employment impacts, we rely on one mainstream approach as the conceptual framework and evidence derived from studies using this approach to obtain some insights and broad estimates.

The core premise in the conceptual framework is that the stock of infrastructure assets provides services that contribute to long-term economic growth. Stylized production functions are used to specify the relationship between the value of output as the dependent variable and factors of production such as human and physical capital, the stock of transport infrastructure, and other resources and attributes as independent variables.[57] A key issue to note here is that the long-term output generated is not related to the expenditure on roads (investment or current) but to the services provided by the stock of capital.

Hence, an addition to the stock of the roads infrastructure, through investment expenditure, contributes to a stream of output for the years during which it is serviceable. As noted above, the investment could be a new road, or the upgrading or rehabilitation of an existing one. Maintenance intended to keep roads in a serviceable condition, preserves the ability of the road to continue generating the stream of outputs but does not generate additional outputs. Two issues noted above that need to be addressed in providing estimates of generated employment at the macro level are: (a) the wide variations in the estimates of impact; and (b) the absence of estimates of employment impact. We address the first issue by placing the impacts in a range based on a review of selected evidence on the elasticity[58] of economic output with respect to change in the stock of roads infrastructure.

On the second issue, we use evidence from roads impact studies along with evidence from selected studies that estimate the employment elasticity of economic output.[59] Following Estache and Garsous (2012b), the employment (E) elasticity with respect to a change in roads infrastructure stock (Rd_Stock) is:

% change in E / % change in Rd_Stock
(% change in E / % change in GDP) X (% change in GDP / % change in Rd_Stock).

Table 12 shows the range of values for infrastructure stock elasticity of GDP and GDP elasticity of employment and, based on these, the computed road stock elasticity of employment. We have provided a range of elasticities from selected studies since estimates vary. The range of low-, medium- and high-employment elasticities in table 12 is based on Crivelli at al. (2012) who use evidence between 1991 and 2009 from 167 countries. They find that 70 per cent of employment elasticities are in the 0.25–0.8 range. This evidence is broadly consistent with the earlier study, Kapsos (2005), which found that the majority of employment elasticities were in the 0.25–0.75 range.

From a meta-analysis, Melo et al. (2013) find that the mean road infrastructure stock elasticity of GDP was 0.088 with a median of 0.045 implying a substantial skew to the right. In other words, half the elasticities are below and half above 0.045 but the mean is pulled higher because of some very high elasticities in relation to the median. However, Menson (2012) finds higher infrastructure elasticities for per capita GDP (0.15 excluding roads and 0.17 including roads). Canning and Bennathan (2004) estimate the elasticities to

[57] The stock of roads (more precisely the value of the stock) is a part of the physical capital. In order to estimate its contribution to economic growth, the stock of roads is included as a separate variable.

[58] Elasticity is a widely used concept that, in this case, represents the change in output for a 1 per cent change in the stock of infrastructure.

[59] Where output is usually represented by the GDP or value added.

be 0.05 for countries in the lowest quartile by GDP per capita, 0.09 for middle income countries and 0.04 for high income countries. From a review of the evidence, Estache and Garsous (2012a; 2012b) conclude that GDP and employment elasticities are higher for LMICs because of their more acute infrastructure deficits. An intuitively appealing interpretation is that inadequate infrastructure is a severe constraint on development for these countries but their development is more responsive to the alleviation of this constraint because of the existence of complementary conditions required for development.

Table 12. Range of road stock, GDP and employment elasticities

	Assumed values for estimates of impacts		
Elasticities	Low	Medium	High
% change in employment (E) / % change in GDP	0.250	0.500	0.750
% change in GDP / % change in roads assets (Rd_Stock)	0.040	0.080	0.120
% change in employment (E) / % change in road assets (Rd_Stock)	0.010	0.040	0.090

Source: Author's assumptions based on evidence from Crivelli et al (2012), Canning and Bennathan (2004), Estache and Garsous (2012b), Kapsos (2005), Melo et al (2013) and Menson (2012). .

The elasticities are measures of single responses[60] while a unit of investment will continue to deliver the impact during the lifetime of the asset. In other words, following investment in the roads sector, the improved state of the road continues to deliver economic benefits in the form of higher output and employment benefits in the form of more employment as long as it remains in the improved state. Therefore, it is not sufficient to compare the cost of the investment with the output and employment impacts in a single year. A form of return on investment approach is required to assess the impact on the economy. Following Canning and Bennathan (2004) the return on investment is not the conventional return to private sector investment but the stream of additional value to the economy as a whole.

To illustrate the assessment of impacts of investment in the roads sector (measured by the value of addition to the road stock), it is necessary to have actual values of investment, the GDP and employment and changes in these variables. To illustrate, we return to the hypothetical case of a small- to medium-sized developing economy used for the simulation in section 4.2 (see table 10) and some further assumptions, notably, the replacement value of road assets.[61] Assuming the level of roads sector expenditure at 10 per cent of the public sector expenditure as in the simulation in section 4.2, the amount is 6.7 per cent of the value of road assets. For the illustration, the expenditure is separated into two-thirds investment and one-third maintenance.[62] Further, it is assumed that the

[60] Typically studies use annual or annualised data and therefore the elasticities measure the annual response.

[61] It was noted in section 2.2 that a typical value for countries in sub-Saharan Africa was 30 per cent.

[62] It was noted in section 4.2 that roads sector investment expenditure is typically 10–20 per cent of capital expenditure and maintenance expenditure is 2–4 per cent of current expenditure. Gwilliam et al. (2011) noted that, typically, two-thirds of roads sector expenditure is on investment and one-third on maintenance.

investment expenditure represents the replacement value of the investment and, hence, is the addition to capital stock (4.3 per cent in table 13).

Using the low, medium and high elasticities in table 12 and the assumptions in the previous paragraph, we have increases in annual GDP of 0.17, 0.35 and 0.52 per cent, respectively calculated in table 13 as impacts of one year's roads sector expenditure. The corresponding high, low and medium increases in employment in fulltime equivalent years of employment are 0.43, 1.73 and 3.9 per cent of the labour force.

Following Canning and Bannathan (200$), the rate of return of the road sector investment for the economy (r in the formula below) is calculated from the following formula:

$$\sum_{t=1}^{\infty} \frac{MP_t - dp_0}{(1+r)^t} = p_0$$

where MP_t stands for the marginal product of the investment in period t (represented by the increase in GDP as a result of the investment, p_0), d is the depreciation (or maintenance cost required to prevent deterioration), and p_0 is the initial cost of the infrastructure (essentially the investment cost). The left-hand side of the equation is the present value of the stream of investments and the right-hand side the cost of the investment. With the simplifying assumptions of constant marginal product of infrastructure, investment expenditure and maintenance cost after adjusting for inflation, the formula for the rate of return simplifies to:

$$r = \frac{MP - dp_0}{p_0}$$

The simplifying assumption is that once the investment is made, it continues to generate a constant level of return in the form of additional GDP net of the depreciation of the road asset or the cost of maintenance required to preserve the asset in serviceable condition.[63] Using this formula, the rate of return to the economy of the investment expenditure is 11 per cent for low elasticities. At the medium and high levels, respectively, the rates of return are 24 per cent and 38 per cent (see table 13),

As for table 10, tables 12 and 13 in Excel format have been made available by the author to explore alternative scenarios and country-specific situations. It is necessary to make some qualifications to the estimates in the table and use of the table to explore alternative scenarios. The GDP and employment estimates in table 13 are based on the assumption that the impacts are immediate. It was observed in box 6 that all the benefits will not be realised immediately after a road improvement since economic decisions to benefit from the improvements and their effects take time to materialize. Further, as noted above, the depreciation/maintenance factor assumed in the calculation is too low, implying that the net generated economic and employment impacts may be lower than estimated in table 13 because of deterioration of existing roads. The Excel based model can be used to

[63] At this highly aggregated level, studies typically make the further simplifying assumption that depreciation is equivalent to the maintenance expenditure required to preserve the asset. In practice, roads have design lives beyond which they need to be reconstructed or replaced. In the rate of return calculations in table 13, following conventional macro studies, the depreciation/maintenance factor applied to the annual investment, p_0, is 2.33%, i.e. the calculated maintenance cost as a per cent of the total value of assets in the hypothetical case based on international evidence. Strictly speaking the depreciation figure should include an allocation for replacement to ensure that depreciation is not understated and the return not overstated.

explore the actual situation with sufficiently high allowances for depreciation and maintenance.

There are a number of other critiques of this approach and the results should, therefore, be interpreted with qualifications and as indicators of the order of magnitude rather than precise numbers. While Canning and Bennathan (2004) use this approach to some effect, they note that it excludes some welfare effects (e.g. increased leisure) and other externalities, which are not included in the GDP.

Another critique (Lakshmanan, 2011) is that the approach does not provide insights into the qualitative and dynamic effects associated with development processes, decisions at the individual and business levels, increased connections, and flows of goods and people and innovation. On the other hand, there is a risk that the quantitative impacts may be overstated because some important variables are omitted. Lakshmanan (2011) points to one such variable, the level of urbanization in the economy, which is strongly correlated with growth in GDP. The issue however is complex since improved transport contributes to urbanization.

Some of the differences in the generated GDP and employment impacts of roads improved by investment revealed by macro level studies may reflect differences in methodologies and data estimates. However, there are also differences between countries and regions in the impacts because of the differences between them in their resources, development status, policies and practices at the national, local and sectoral levels and how effectively they are implemented. The countries with higher GDP and employment impacts of investment in the roads sector provide lessons for improving the economic and employment impacts through changes in policies and their implementation.

Table 13. GDP and employment impact scenarios

Country information		Assumptions	Comments
	50	–	–
Economically active population (million)	30	60	% of population
Employed labour force	25.5	15	Unemployment rate (%)
GDP (US$ eqv.)	62 500 000 000	–	–
GDP per capita (US$ eqv.)	1 250	–	–
Government expenditure (US$ eqv.)	12 500 000 000	20	% of GDP
Roads sector expenditure (US$ eqv.)	1 250 000 000	10	% of government expenditure
Value of roads assets (US$ eqv.)	18 750 000 000	30	% of GDP
Roads sector expenditure as % of road assets	6.67	–	–
Of which construction (replacement value) (US$ eqv.)	812 500 000	–	–
% addition to road assets	4.33	65	% of total
Of which maintenance (US$ eqv.)	437 500 000	–	
Of which maintenance (% of assets)	2.33	35	% of total

Generated output and employment scenarios (low medium and high GDP and employment elasticities (see table 12)

	Low	Medium	High
Annual GDP impact (US$ eqv.)	108 333 333	216 666 667	325 000 000
As % of GDP	0.17	0.35	0.52
Rate of return (%)	11.00	24.33	37.67
Employment impact (FTE years)	110 500	442 000	994 500
Annual employment impact (% of labour force)	0.43	1.73	3.90

Notes: 1. Eqv. = equivalent. 2. FTE = Fulltime equivalent.

Source: Developed by the author.

5.2.2 Two studies of project and programme employment impacts

As noted earlier, relatively few studies address generated employment impact per se. Two recent examples are a study in Nigeria of the impacts of highway construction (Ali et al., 2015),[64] and a study of the employment impact of the Pradhan Mantri Gram Sadak Yojana (PMGSY)[65] rural roads programme in India (Asher and Novosad, 2016). These two studies have been used as illustrations of the employment impacts of highways and rural roads, respectively.

[64] Although strictly speaking, the focus of this study is not on the employment impact but more broadly on the economic development impact of investment in highways.

[65] Indian Prime Minister's Village Roads Scheme to provide road access to all villages with populations above 500.

Ali et al. (2015) look at the whole network evidence combining data on the whole of the road network and evidence from satellite imagery of luminosity, which is increasingly being used as a proxy for the level of economic activity. The study found evidence of increases in farm and non-farm incomes and in year-round employment, as table 14 below shows. However, it also found a reduction in agricultural employment implying a shift away from low productivity farm employment while improving livelihoods. As indicated earlier, the impact on employment and livelihoods is therefore more complex than merely increasing the amount of employment.

Tables 14 and 15 show changes in household incomes and output elasticities related to highway investment. At the macro level, the employment effect of growth can be measured by using the employment elasticity, which represents the percentage increase in employment for a 1 per cent increase in GDP growth. If a transport cost reduction of 10 per cent leads to a 5 per cent improvement in local GDP as table 14 shows, given the employment elasticity of GDP growth of 0.62 per cent for Nigeria (Kapsos, 2005), an employment growth of 3.1 per cent can be inferred from a cut in transport costs of 10 per cent, as a consequence of roads sector investment.

Table 14 shows increase in GDP per km of road length improved, the population affected and the per capita benefit for the population affected. By looking at the evidence in tables 14 and 15 together it can be deduced that the benefits arise from increased employment (increase in year round employment in table 14) and more productive employment (decline in agricultural employment in table 14 implying a shift away from less productive employment). Since the evidence is at an aggregated average level it does not show the distribution of gains and losses.

Table 14. Example of impacts of major roads: Nigeria highway corridors study

Welfare indicator	**Benefit (percentage change resulting from a 10 per cent reduction in transport costs)**
Crop revenue	3.8
Livestock revenue	–
Non-agricultural income	3.9
Year-round employment	
Male	0.4
Female	0.3
Agricultural employment	
Male	–4.0
Female	–5.3
Multidimensional poverty index (MPI) reduction	2.6
Wealth index	2.0
Local GDP (from luminosity evidence)	5.0

– = negligible.

Note: Estimates are calculated using the natural path instrument. Revenue figures are gross.

Source: Ali et al. (2015).

Table 15. Estimated benefits of projects: Nigeria highway corridors study

	GDP increase (US$ million, 2006 PPP)[1]	Road length (km)	GDP increase per km (US$ million)	Population affected (millions)	Per capita benefit (US$ per person affected)
All projects	1 794	2 774	0.65	39.32	45.63
North-south corridor	1 082	1 121	0.97	23.12	46.81
Northeastern corridor	233	939	0.25	14.88	15.66
Southern corridor	529	729	0.73	9.16	57.73

[1] Purchasing power parity.

Source: Ali et al. (2015).

Asher and Novosad (2016) specifically focus on the effects of improved rural roads on employment. Their econometric study of the impact of investment in rural roads under PMGSY, which corrects for selection bias favouring villages with greater growth potential, found a 10 per cent reduction of households engaged in farming and an equivalent rise in non-farming wage employment. The shift is most marked for males and households with low levels of land and for those living closer to urban areas, and is accompanied by increases in household earnings and assets. An impact assessment study adopting a survey approach (India. Ministry of Rural Development and ILO, 2015) of the impact of well maintained PMGSY roads supports the conclusion reached by Asher and Novosad (2016) and provides more insights.

Both the above examples illustrate an aspect of the complexity of the employment impact of roads sector expenditure or other changes in the rural economy context referred to in section 5.1. The investment may not increase employment but create the conditions for shifts from lower productivity to higher productivity work. Depending on the context, investments in roads have other types of impacts listed in Table 11. In the next section we use additional examples to illustrate these.

5.3 Roads sector expenditure, and rural employment and livelihood impacts

This section focuses on the impacts of roads sector expenditure on the rural economy. As noted earlier, given the nature of the rural economy, notably the predominance of informal and own account employment, the links between the economic development effects of improved roads, and employment and livelihoods are complex and context specific. The employment impact does not only manifest itself in increased employment but also in more productive employment leading to poverty reduction, especially if the road improvements target the categories of roads with the most severe access constraints for rural households. As noted in section 1, there are a large number of studies using a range of approaches to examine the evidence and a number of study reviews. The latter are from differing perspectives and examine different dimensions of the impacts of roads improvement. The aim here is not to provide a comprehensive review of studies but to use the evidence selectively to focus on rural employment and livelihood impacts.

Table 16 summarizes selected evidence from a number of studies on the impacts of roads on the rural economy more generally, and on employment, which have been related to the different types of effects identified in table 11. The Bangladesh study (Khandker and Koolwal, 2011) shows a shift away from low productivity farming to non-farm

employment implying a shift from low productivity to higher productivity work with increased food expenditure for categories of households benefiting most from the shift. The China study (Fan and Chan-Kang, 2004) also referred to earlier in section 2.2, reveals evidence of increases in agricultural and non-agricultural GDP with implied growth in employment and/or self-employment related to investment in lower specification rural roads. The increase in non-agricultural output is estimated to be much higher.

The Ethiopian studies (Dercon and Hoddinott, 2005; Dercon et al., 2008) are in a context in which livelihoods are predominantly subsistence farming based. The benefits of better access, especially to local market towns are improved livelihood prospects because of the lower costs of inputs and consumer goods, and better opportunities to sell farm and non-farm produce. By contrast, as a consequence of improved roads, the Georgia study (Lokshin and Yemtsov, 2005) shows shifts towards wage employment and small enterprises that offer more productive and remunerative work than farming.

The two studies of the impacts of rural roads construction under PMGSY (Bell and Van Dillen, 2012; Asher and Novosad, 2016) indicate different types of impacts. The former assesses the benefits to farmers of higher product prices, the potential of offering a wider range of produce for sale and lower costs of inputs, which improve their livelihoods. The latter, focused specifically on measuring the employment impact, identified households with less land or even functionally landless as shifting out of lower paid farm labour to better paid non-agricultural work. The findings of the studies are not necessarily in conflict since they assess the effects for households with different characteristics.

Rural households typically rely on more than one livelihood source, often combining farm production for subsistence or for the market with non-farm work. The Indonesian study (Olivia and Gibson, 2009) demonstrates that improving rural roads increases access to non-farm employment opportunities, although, in this case, not by a large amount. The qualitative appraisal studies in Indonesia, the Philippines and Sri Lanka (Hettige, 2006) provide an overview of a range of different types of effects specific to the context and circumstances of the households. They include increased employment, expanding businesses, and increased farming productivity and incomes.

Hettige (2006) found that the rural roads investment near Yogyakarta in Indonesia, had increased people's ability to transport goods, provided opportunities for those with skills and/or savings to invest in small businesses and small stores, or to become intermediaries, selling community products in nearby markets. Among respondents benefiting from improved roads, 64 per cent observed that the number of small businesses in the community had increased since the road had been built or rehabilitated. Of those who had started a business since the road's rehabilitation, 69 per cent declared that it had been a factor in their decision to start a business. Also, 54 per cent of households declared that more buyers had visited the community than five years prior to the rehabilitation project (compared with 36 per cent of control households in locations with unimproved roads reporting more visitors than five years ago).

Table 16. Road investment and rural employment – selected evidence

Country and study	Effect on employment	Effect types[1] and comments
Bangladesh (Khandler and Koolwal, 2011)	20–22% decline in agricultural employment, coupled with a 14–17% rise in non-agricultural employment.	1(b) implied by higher wages in non-farm employment.
	Increased per capita food expenditure for households in the 25–50% income percentile range suggesting higher labour mobility for this group.	2 indicated by shift of employment from lower productivity farming to non-farming accompanied by higher food consumption.
China (Fan and Chan-Kang, 2004)	Each additional km of rural roads generated CNY[2] 1 million of non-farm GDP and CNY[2] 0.29 million of agricultural GDP.	1(a) implied by generation of agricultural GDP. 2 and 3 implied by generation of non-farm GDP.
Ethiopia – longitudinal study of 15 villages (Dercon and Hoddinot, 2005; Dercon et al., 2008)	Access to local market towns affects rural economic activity. Households more remote from local towns are less likely to purchase inputs or sell products including artisanal products made by women.	1(a) and (c) implied. Poverty reduction and higher consumption related to better access.
	Communities with better roads have persistently higher growth rates than others. Access to all-weather roads reduces poverty by 6.9% and increases consumption growth by 16.3%.	
Georgia (Lokshin and Yemtsov, 2005)	Improved road project villages compared with control villages.	1(b) implied by increased wage employment. 1(c) implied by increase in SMEs.
	More off-farm and female wage employment in project villages. Off-farm employment improved for non-poor households and female wage employment increased for poor women.	2 indicated by shift from farming to non-farming.
	The share of villages with small- and medium-sized enterprises (SMEs) significantly increased in project villages.	3 implied by increased wage employment.
	No impact of road quality on agricultural product sales.	
India – Orissa (PMGSY) (Bell and Van Dillen, 2012)	Increases in farm-gate prices of rice (5%) with greater benefits for vegetables and other crops, and lower costs for fertilizers and chemicals.	1(c) higher net farm incomes. See also Asher and Novosad (2016) below.

Country and study	Effect on employment	Effect types[1] and comments
India (PMGSY) (Asher and Novosad, 2016)	Road construction to previously unconnected villages leads to 10% reduction in the share of households and workers in agriculture, with an equivalent increase in wage labour market participation. Shift concentrated among males and households with low levels of land and closer to urban areas. 8% increase in household earnings, 20% increase in the share of households living in houses with solid roof and walls, and increase in the growth rate of night light luminosity following road construction.	Clear evidence of 2 and 3 – shift away from agricultural to non-agricultural employment and improved living standards. In the context of high landlessness and rural unemployment. Also see Bell and Van Dillen (2012) above.
Indonesia (Olivia and Gibson, 2009)	Upgrading rural roads increases the likelihood of being engaged in non-farm employment by just over 4%.	2 and 3. Increased opportunities for income diversification.
Indonesia Philippines Sri Lanka (Hettige, 2006)	To increase income, project households would find employment locally (7%) or expand a small business (22%). In contrast, control households would expand agricultural production (29%) or raise small animals (22%).	1(a), 2 and 3 with variations between countries and projects – implying higher reward in non-farm activities. Households with no improved roads rely more on farming.
Madagascar (Jacoby and Minten, 2008)	Modelling the effects of high transport costs in Madagascar because of inadequate rural roads. A new rural road would reduce transport costs and improve incomes of the remotest households by 50%, mainly from non-farm earnings.	2 and 3. Indicates limited agricultural potential.
Nicaragua (Goss Gilroy Inc. and Orbicon for DANIDA, 2010)	Net 17% increase in employment for project communities in agricultural and non-agricultural activities (mainly construction). Improvements in agricultural incomes reported because of improved market access including new markets for cattle and milk, and higher prices for producers.	1(a) and (b), 2 and 3. Indicates agricultural potential and non-farm employment opportunities. Labour-based road construction provided incomes and developed construction skills, which improved non-farm employment opportunities.
Peru (Escobal and Ponce, 2002)	Improved motorized roads increased non-agricultural wage employment by 9% but agricultural self-employment declined by 8%. Non-agricultural wage income per capita increased by US$115 per year.	2 and 3 (the latter inferred). Implies low productivity in farming and limited agricultural potential.

Country and study	Effect on employment	Effect types[1] and comments
Rwanda (OTF, 2010 reported in Government of Rwanda, 2013)	Farmers within 7–10 km of a main road receive 85–160% higher prices for their produce than those further away.	1(a) – lower transport costs resulting in higher farm-gate prices for products.
Various sub-Saharan African countries – 42 (Dorosh et al., 2010)	Total crop production relative to potential production is 45% for areas within four hours' travel time from cities of 100,000 people. It is just 5% for areas more than eight hours away. Agricultural production is positively correlated with proximity to urban markets and adoption of high-productive/high-input technology is negatively correlated with travel time to urban centres.	1(a) – lower transport costs and better access to market improves productivity.

Notes: 1. The numbers in this column refer to the types of effects described in table 11. For example, 1(a) refers to "More productive use of existing human and other resources – higher productivity". 2. Chinese Yuan Renminbi.

The Madagascar study (Jacoby and Minten, 2008) models the effects of high transport costs for the remotest households based on data from households with varying levels of remoteness. It concludes that the remotest households could improve their incomes by 50 per cent, but mainly with non-farm earnings, if a rural road improved their access. The Nicaragua study (Goss Gilroy Inc and Orbicon, 2010) is an evaluation of the impact of a labour-based rural roads programme focusing on the impact of the improved roads. The study shows almost all the types of effects identified in table 11, through improvements in farm incomes, and farm and non-farm employment opportunities. By contrast, in the Peru study (Escobal and Ponce, 2002) there is an unambiguous shift of employment from farming to non-farming.

The Rwanda study (OTF, 2010 reported in Government of Rwanda, 2013) is an example of lower transport costs resulting in higher farm-gate prices and, hence, better livelihoods for farmers with better access. Dorosh et al. (2010) developed a model for analysing evidence from 42 countries in sub-Saharan Africa to assess how travel time to urban centres affects the development of agricultural potential. The study found that areas within four hours of urban centres with populations of 100,000 or more persons reached 45 per cent of their agricultural potential, while areas eight or more hours away from urban centres reached just five per cent of their potential. The evidence supports the proposition that access to the urban market provides an incentive to make more productive use of resources and to adopt more productive technologies. Access to better technologies may also be easier closer to urban centres.

Some observations and qualifications on the evidence discussed above are in order. In a number of cases, it has been necessary to infer the employment impacts. Further, if a reported study does not show a type of effect, we cannot conclude that the effect was not there. The study may have been designed not to test for the effect or that it may not have investigated that effect. Bearing these complications in mind, the employment and livelihood related impacts outlined above could be related to the different types of rural households briefly characterized in section 3.5.

The list in table 16 is selective and intended to illustrate the range of results and types of studies. There are numerous other studies that have not been cited. For example, Mu and van de Walle (2011) found evidence of diversification of livelihoods in Viet Nam with the impact being the greatest in rural communes. From a review of rural roads projects in Nepal, Starkey et al. (2013) found 25 per cent increases in average incomes and food security along the new road corridors. Socio-economic surveys reported by Ahmed (2010) following rural road improvement in Kenya showed that most of the new movements along the rehabilitated roads were for work, business opportunities, and health-related visits. Gachassin et al. (2010) studied the impact of rural roads in Cameroon and observed that improvements in livelihoods were a result of increased opportunities for non-agricultural employment.

The studies cited above also observed that within the rural context the impacts were not generally pro-poor. Starkey et al. (2013) found that while the impact of roads investment was a 15 per cent increase in the incomes of ‘disadvantaged’ ethnic groups, the increase for the ‘non-disadvantaged’ groups was 37 per cent. Mu and van de Walle (2011) found that the poverty reduction impacts were the greatest where roads reached the remoter, poorer communes. The implication of the studies referred to above and the conclusion reached by Hettige (2006) is that road investments increase economic activity and reduce poverty, but people with resources (the non-poor) tend to benefit most. In assessing the poverty impact of roads in Cameroon, Gachassin et al. (2010) also concluded that a more targeted approach is needed to reach the poorest communities. This relates to

the broader issue of the allocation of resources between highways and rural roads to ensure an adequate level of access for the rural population to which we will return below.

Gollin and Rogerson (2010) look at the relationship between the high transportation costs and low productivity of the agricultural sector, and between transport costs and the size of the quasi-subsistence sector. They provide detailed information about the scale of transportation costs in Uganda. The country has a low level of physical infrastructure and public services, with more than three-quarters of the population living two or more hours from any market centre. They find that the geographically high dispersion of prices reflects the underlying transportation costs, which are obstacles to arbitrage between regions.

Their analysis is supported by a study conducted by the Government of Uganda (2002) estimating the costs of moving food from rural to urban areas. With a farm-gate price between 50 Ugandan shillings (UGX)/kg and UGX65/kg for maize, the transport and logistical costs of moving produce to urban wholesale markets was estimated to be UGX55/kg, about the same as the farm-gate price. Comparing a matching situation in the United States, Gollin and Rogerson (2010) estimate that the implied unit transport cost in Uganda is about seven times the cost in the United States.

Findings of studies on the impact of roads have to be qualified in three ways: (a) impacts of road improvements recorded by studies cannot be fully generalized because roads are typically improved where their benefits have been perceived to be the highest; (b) roads benefit those who are better off and are endowed with more productive assets; and (c) the functioning of the transport service sector has implications related to the benefits for the road users and employment impact, as noted in section 3.

Barrett and Swallow (2006), among others, have found that households with access to adequate assets and infrastructure, and faced with appropriate incentives, engage actively in markets, while those who lack one or more of those three essential ingredients do not. Broadly speaking, the literature on farmers' decisions to participate in the market finds that differences in transaction costs, and differential access to assets and services to mitigate these costs are possible factors underlying heterogeneous market participation among smallholders.

Hettige (2006) questioned the assumption that investment in roads should spontaneously lead to the private sector providing transport services, so that the increase in competition rapidly leads to cheaper and better transport. The case study analysis showed that in each case, investments in rural roads decreased travel time and led to the emergence of a variety of transport modes, but increases in transport volume and decreases in fares occurred only when there was competition among transport providers. Therefore, effective competition in the transport service sector is a critical precondition for the gains from the improvement of roads to be passed on to users. A number of researchers confirm this analysis and show that, in Africa, transport costs are not necessarily excessively high, but rather that the lack of competition in trucking services, and the costs imposed by regulation and controls of the transport of goods and how they are implemented, keeps transport prices high (Moser et al., 2005; Raballand and Macchi, 2008; Teravaninthorn and Raballand, 2009; Raballand et al., 2010; USAID, 2011; Porto et al., 2011).

The relative importance of lack of competition and governance issues related to regulations as hindrances varies between contexts. Teravaninthorn and Raballand (2009) found that in West and Central Africa, truck operators participate in freight sharing schemes effectively operating as cartels and keeping transport prices and mark-ups high. There is also a lack of incentive to invest in new trucks. By contrast, in Southern Africa there is better governance of the regulatory regime, more competition, modern and more efficient fleets, and logistical coordination between shippers and transporters is common.

In East Africa, the freight transport market is more competitive than the West and Central African markets with lower prices.

Nevertheless, regulation-related governance imposes delays and costs. A study by CPCS Transcom (2010) found that the transport of a 20-foot container carrying regular consumption goods from Mombasa, Kenya's main port, to Nairobi, the capital, located 430 km inland takes on average 29.8 hours. Most of this time is spent dealing with various regulatory delays, two weight stations, several police checkpoints and driver delays including an overnight stay en route. A similar distance in North America would be serviced in less than six hours. There are also costs associated with officials' rent-seeking.

The issue of relative allocation of resources between different road categories was raised earlier in this paper. Reference was made in section 2 to evidence from China (see table 3) that the generated growth, poverty reduction and employment impacts are higher for rural roads than for highways. Starkey and Hine (2014) cite evidence from studies in different countries and contexts to show that providing basic rural access where it was initially very poor provided the greatest benefits. A study of public investments in rural Uganda suggested that the most basic 'feeder' roads had a benefit-cost ratio of 7.2, with 34 people taken out of poverty for each UGX1 million invested (Fan et al., 2004). The impact of small feeder roads on poverty reduction was three times greater than gravel or tarmac roads, per unit of investment (Fan et al, 2004).

In their World Bank review of rural transport, Banjo et al. (2012) emphasized the need to focus rural transport investments on the lower end of the rural transport network, to include local community roads, paths and trails, in order to meet the rural access and mobility needs of smallholder farmers. Further, the appropriate technology for investment in the infrastructure to provide basic rural access is labour-based. Hence, devoting resources to such improvements would have the added employment impacts during construction, rehabilitation and maintenance referred to in section 4.

6. Summary of findings and lessons for analysis, policies and programmes

This section draws together the main findings and lessons focused on the specific objectives of the paper within the context of Component A (Employment Impact Assessment of Public Policies in Selected Sectors). As noted in section 1, the objective of Component A is to support developing countries and development practitioners in analysing and designing policies and programmes that enhance the positive impact on employment.

The aim of this paper is to appraise the employment impact potential of roads sector expenditure and examine the factors affecting the fulfilment of the potential. This section starts with a summary of the evidence-based appraisal in the paper followed by lessons for analysis, and design of policies and programmes. A distinction is made between the employment impact of roads sector expenditure, and the developmental impact of the improved road infrastructure. The broad conclusions on the expenditure impact are that: (a) there is potential for expanding this impact by more labour-intensive, more precisely labour-based, methods; and (b) there is potential for higher labour intensity in developing, improving and preserving rural roads to include all three categories, major rural roads, rural access and feeder roads, and farm roads and tracks.

In order to increase the direct employment impact of roads sector expenditure, there is a need to either rebalance the allocation of expenditure in the direction of rural roads or increase the expenditure allocated to rural roads. Further, the greater locally and nationally sourced inputs for rural roads and higher local consumption by labour generally leads to higher indirect and induced employment. A balanced approach that does not neglect the rural roads network in allocating resources is required since, while different categories of roads compete for resources, they are also mutually complementary in improving the overall transport situation. To ensure higher employment impacts in addition to the rebalancing, complementary requirements are: (a) policies that promote the introduction and establishment of appropriate labour-based methods for the construction and maintenance of different categories of rural roads; and (b) road designs that are appropriate for the level and nature of use.

The focus in the previous paragraph has been on the allocation of a given level of expenditure. In many developing countries, there is a road infrastructure deficit and a need to make fiscal space in the public sector in order to increase expenditure or private sector involvement. While greater expenditure would increase the employment impact, it is necessary from the point of view of efficiency and efficacy that the level of expenditure be economically justified and that adequate resources be provided to maintain both the existing assets and the newly created ones.

Based on the asset management principle for roads sector expenditure, the following steps and priorities are recommended:

- Identify development objectives related to the roads sector (national, regional and local).
- Determine the core road networks and investment priorities (national, regional and local) based on the development objectives.
- Preserve the maintainable core networks.
- Rehabilitate parts of the core network and then maintain.

- Upgrade parts of the core network where this is justified and then maintain.
- Construct new roads necessary for developing the core network further where justified and then maintain.

The developmental generated employment impacts of the outcome of roads sector expenditure in the form of more and improved roads are more complex, context specific and potentially much higher and longer term, but the nature and level of these impacts depend on complementary conditions and inputs. Lower transport costs contribute to increased economic activity by reducing input costs and improving access to markets and, hence, increases employment in the expanded economic activities. However, where there is a high level of self-employment in the informal sector and underemployment, the employment impact may not manifest itself in increased employment but in a reduction in underemployment, and shift of employment to more productive activities.

Table 17 summarizes the lessons of this paper for analysis and policy design focusing on the employment impacts set in the broader context of the appropriate level of resources allocated to the sector and its effective management. Analysis and policy and programme design are inter-related since the latter should be based on analysis. The analysis column in the table sets out the issues to be investigated in the country context to inform the formulation of policies and programmes. The aim is to recommend studies, and policy and programme design, in the context of the specific countries. The last column specifies the manner in which the policies and programme design impact employment associated with roads sector expenditure, and the developmental effects of improved roads maintained in a good condition.

In some countries, elements of analysis and policy may already be in place. In such cases, the table is an aid to examining the comprehensiveness of the policy framework, and the need for further analysis and policy development, especially with a view to increasing the employment impact. As noted above, according to the asset management approach, the focus should be on preserving, rehabilitating and upgrading assets complemented by new construction of strategic importance at national, regional and rural levels.

We have demonstrated in section 4.1 (see table 10 and related discussion) that the employment impact of roads sector expenditure, with an appropriate focus on the use of more labour-intensive (more precisely labour-based) methods, could be increased from about 0.5 per cent of the national labour force to about 2.7 per cent with the aim of providing employment, and contributing to improved livelihoods for rural households. The issue of whether alternative deployment of expenditure would create more employment is less significant because we start with a given level of expenditure considered necessary for the roads sector and consider the employment impact of using the amount differently. The given level of expenditure can also be defended on the basis of the roads infrastructure deficit in many developing countries, and the complementary rather than competing nature of investment in infrastructure and productive sectors.

Section 5 indicates that it is less easy to provide order of magnitude estimates of the employment impacts associated with the developmental effects of improved roads because:

(a) the impacts are more context specific and differ between rural and non-rural situations and, within each type of situation, the nature of the development and employment effects vary;

(b) the impacts are not just changes in the quantity of employment but also in the quality (e.g. more productive self-employment, a shift from lower productivity and remuneration to higher productivity and remunerated employment);

(c) there are more fundamental transformational longer term effects on the economy and society with related employment impacts that may not be captured by measures of employment.

Table 17. Lessons for analysis and policy and programme design

Areas	Analysis (studies)	Policy and programme design	Employment impact
National policies and strategies	Assess the role of the roads sector in the national, regional and rural development and employment strategy.	Develop policy and strategy for the roads sector consistent with the national, regional, and rural development and employment strategies.	***Investment and maintenance works*** • The balance between: (a) investment and maintenance; and (b) higher specification and paved interurban and lower specification rural roads affecting the employment impact. • The impact would be augmented by the labour-based maintenance for the whole network and labour-based construction and rehabilitation of rural roads. ***Developmental*** • The objective of the policy and network coherence should be to optimize developmental and distributional and related employment impacts.
Coherence of the core network and its development and preservation	Consistent with the development strategy, develop the principles for specifying the coherent core network (national, regional and local) to include specification of the functions and technical aspects.	Identify coherent and complementary national, regional and local networks, and related master plans, with priorities for roads sector investment and maintenance programmes.	
Managing and financing road networks	Appraisal to determine the appropriate legal and financial frameworks within the country context for: • the national network (to include interurban highways); • the rural road networks at different levels.	Establishment of management structures, accountability and financing arrangements to include: • an autonomous roads board and fund; • public-private partnerships where appropriate for national highways; • local ownership including community ownership with support for the lower category roads; • decentralized decision-making and accountability.	***Investment and maintenance works*** Effective management and financing of all parts of the roads sector to maximize the employment impact using the labour-based approach, as appropriate. ***Developmental*** Effective management and financing of all parts of the network to improve and preserve the roads network for the developmental impact.

Areas	Analysis (studies)	Policy and programme design	Employment impact
Investment and maintenance strategy	Road classification based on function and traffic volumes and types and inventories. Appraisals to determine the appropriate construction and maintenance regimes. Assessment of: • the employment impact potential of roads sector investment and maintenance including through labour-based methods; • the obstacles to the use of the appropriate labour-based approach (institutional and capacity related). Recommendations on: (a) appropriate use of labour-based methods; and (b) removal of obstacles.	Policies in line with road classification, and construction and maintenance regimes determined by the analysis.	***Investment and maintenance works*** Employment impact is determined by: • the balance of: (a) construction and maintenance; and (b) highways and rural roads; • adoption of labour-based approach for maintenance of all roads and rural roads construction. ***Developmental*** Higher developmental benefits, and their appropriate distributional and employment impacts (augmented by the appropriate use of labour-based methods).
Transport services	For national (including interurban) highways and major rural roads: • appraisal of the effects of transport service cartels, regulations and other impediments to passing on lower costs to end-users, and improving transport services; • recommendations on the removal of these barriers. For rural roads (major, feeder and farm): • appraisal of regulations and other impediments to passing on lower costs to end-users and improving transport services; • recommendations on the removal of these barriers; • appraisal to determine the initiatives needed to support micro- and small-rural enterprises to enter the transport services market, and innovations in developing IMTs.	Implementation of policies and initiatives based on the analysis and resulting recommendations on: • competition policy to make transport service markets more competitive and to lower entry barriers; • initiatives to provide credit for and promote innovations in intermediate modes of transport (IMTs).	***Developmental*** Higher developmental benefits of lower transport costs, and improved availability and quality of transport through: • increased competition and removal of impediments (higher level roads); • increased competition and innovations in NMTs and IMTs on rural roads. The higher developmental benefits leading to employment impacts.

In spite of the above qualification, it is possible to: (a) provide a range of figures of the developmental employment impact at the macro level; and (b) outline some trends and factors influencing the nature and magnitude of developmental and employment impacts. At the macro level, there is evidence of growth in the stock of the roads sector contributing to growth in GDP and related employment growth. Empirical studies suggest that GDP elasticities with respect to changes in the stock of infrastructure (or roads sector capital) are mostly in the 0.04–0.12 range. Employment elasticities with respect to change in GDP are mostly in the 0.25–0.75 range depending on labour intensities of productive sectors and the sectoral composition of growth.

Based on these ranges of elasticities, a simulation assuming typical annual roads sector investment and maintenance expenditure levels for a small to medium sized developing country shows that the generated employment impact of the annual investment would be just 0.43 per cent per year of the labour force at the low end (assuming low GDP and employment elasticities with respect to roads sector investment). Assuming medium and high level elasticities, the annual generated employment impacts of one year's roads sector expenditure would be 1.73 per cent and 3.9 per cent of the labour force, respectively,

Macro-level estimates provide an overview of the relationship between the improved roads sector and its impact on economic output and employment. However, there are some challenges in interpreting and using the evidence. If the focus is on preserving the stock of roads at a good standard and making incremental improvements and additions, it is not clear whether the measures of infrastructure used in macro studies capture the effects of such changes sufficiently well.

In the rural context the features of the impact are:

(a) improving the quality of employment for those engaged in the informal sector and the underemployed by making their employment more productive and offering additional employment opportunities;

(b) improving access to new employment opportunities to new unemployed entrants to the labour force;

(c) improving rural access at a basic level with lower expenditure per unit has a greater impact on rural livelihoods and employment impact and is more pro-poor than investment in highways.

The implication is the need to analyse and determine the balance between rural and non-rural roads sector expenditure.

The previous section (and section 3.7) referred to the need for a competitive transport service sector. A distinction was made between the market structure, demand and supply features of transport services on rural roads and interurban highways. The last part of table 17 summarizes the analysis requirements and policy implications. The need for policies that promote competition and reduce regulatory burdens, and how they are implemented, are clearly important. In the rural context, local small-scale enterprises in the sector should be supported, and the unintended entry barriers imposed by such regulations avoided. The evidence reviewed in this paper on differences between countries in the nature and magnitude of the employment impacts of roads sector expenditure and the developmental impact of the improved road infrastructure demonstrates that there is scope for countries with less good performance to learn from the better performing countries.

The focus of this paper has been on the positive employment impacts of roads in developing countries. Further, the advent of information and communication technologies are already augmenting and transforming the impacts of improved roads. However, there are also some adverse economic impacts and externalities that need to be considered when analysing and formulating policy. The former are for those who lose from improved roads and communications while the latter are the spread of diseases, increased accidents and environmental pollution.

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