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## **ADB Working Paper Series**

### **Globalization, Infrastructure, and Inclusive Growth**

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**Abstract**

This paper covers three issues: first, defining and measuring inclusive growth; second, the relationship between international trade and inequality; and third, the links between infrastructure and inequality. Both international trade and infrastructure make it easier for people to exchange goods and services and to increase income by allowing specialization, economies of scale, variety, etc. The gains are important not only in aggregate, but also at an individual level, and different people's ability to take advantage of them varies. Hence each *can* increase inequality. Critical to sharing the gains from trade is mobility—specifically labor mobility, which determines the capacity of people to move from areas, sectors, skills, or firms of low or declining opportunity to those of higher opportunity. In the context of inclusive growth, this constitutes a challenge. However, the answer should not be to eschew opening up the economy or building infrastructure, but to do so in an informed way and seek to undertake complementary policies that help the less well-off take advantage of them.

**JEL Classification:** F16, F64, H54

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# 1. INTRODUCTION

This paper touches on three of the biggest topics that can confront an economist, and lurking behind them is a fourth:

**Inclusive growth** is a major challenge for economic policy, especially in East and Southeast Asia where solutions have been found for much of the extreme poverty that blighted the region forty years ago. Over the decades, developing economies have been getting better at achieving growth, but have seen the benefits of that growth concentrated in the upper reaches of the income distribution. In many countries the challenges of providing livelihoods for low- and middle-skilled workers seem formidable.

**Globalization** is arguably the most important dimension in the economic circumstances that face most countries. We had globalization in the 19th century, but in the 21st century it is deeper and works faster. Capital mobility has declined in the last five years, but it is still high, with trillions of dollars moving around the world each day; workers would move around the world much more if they were permitted to; goods and services *do* move in unprecedented quantities, and with modern communications technologies penetrate far further into economies and societies than was previously possible. In determining development strategies, even the largest developing economies (e.g., People's Republic of China [PRC], India, and Brazil) have to embrace globalization and for smaller ones the relevance is even greater.

**Infrastructure** is one of the policy responses that most readily springs to mind as a way of both stimulating and spreading the benefits of economic growth. There is no simple formula for the optimum amount of infrastructure, but at the broadest level it is one of the requisites for development, and providing it is one of the most important functions of government.

Behind all three phenomena are ***institutions***; sound institutions are a vital ingredient for economic growth. They are necessary for globalization to function effectively and for countries to engage with it effectively, and they are key to both the creation of infrastructure and its management in the common good.

This paper will deal only with the following three dimensions of the issues:

- defining and measuring inclusive growth,
- international trade and inequality, and
- infrastructure and inequality.

I am going to take it as given that both infrastructure and international trade have significant positive effects on countries' levels of income; that is, I will take as given the growth part of inclusive growth and focus only on the inequality part—the extent to which infrastructure and trade liberalization may have seriously uneven effects on different parts of society.

Two themes bind the results together. First, the 'gains from trade': both international trade and infrastructure make it easier for people to swap one good/service for another and so increase income by allowing specialization, economies of scale, variety, etc. These gains are important not only in aggregate, but also at an individual level, and different people's ability to take advantage of them varies. Hence each *can* increase inequality. Second, critical to sharing the gains from trade is mobility – specifically labor mobility, which determines the capacity of people to move from areas, sectors, skills, or firms of low or declining opportunity to those of higher opportunity.

I do not analyze financial globalization in this paper. I do note, however, that while it often appears that financial development is unequalizing because it seems to concentrate resources into fewer hands and may create crises that are bad for the poor, there is at least some evidence that this aspect of globalization is also equalizing (see Beck, Demirguc-Kunt, and Levine 2007).

## 2. INCLUSIVE GROWTH

Defining inclusive growth is simple intuitively, but practically it is complex because it combines the concepts of growth and distribution into a single measure and thus requires one to specify the trade-off between them.

On the objective of ‘shared prosperity’, the World Bank (2013) states that ‘We will monitor progress in shared prosperity using the income growth of the bottom 40% of a nation’s population.’ This implies that a country with an evenly spread growth in income of 1% will be ranked as equivalent to one with no aggregate growth but in which 0.4% of national income is redistributed from the top 60% of the income distribution to the bottom 40%. Over the pre-crisis period of 2003–2007, 168 of the 198 countries for which we have data averaged gross domestic product (GDP) growth in excess of 1% p.a., and even in the height of the crisis over 2008–2011, 105 out of 194 did. Redistribution, on the other hand, is difficult for governments, so we can infer that the World Bank’s measure is going to focus mainly on growth. Moreover, it pays no heed to the fairness of the distribution of the gains from growth.

The International Monetary Fund researchers Balakrishnan, Steinberg and Syed (2013) define growth as inclusive if ‘it is not associated with a reduction in the income share of the bottom quintile of the income distribution.’ This offers a lexicographic trade-off; no amount of growth qualifies as inclusive if the bottom quintile does worse than average. This raises distribution above growth and runs the risk of proclaiming, for example, that the PRC’s growth, which has brought hundreds of millions out of poverty, is somehow inadequate. Others offer a more general concept in which the trade-off is rather complex, but demands more redistribution. Anand, Saurabh, and Peiris (2013) ask whether the ‘general concentration curve’ of income has risen between two years of comparison. The general concentration curve orders the  $N$  incomes in an economy from lowest to highest and plots the ratio of the mean income of the bottom  $k$  incomes to the overall mean against  $k$  for  $k = 1, \dots, N$ . If, over a given period, everybody gets just the average growth rate of income, the concentration curve does not move because all the averages go up by the same amount; hence on this definition inclusive growth requires larger proportionate increases at the bottom than the top, but the exact trade-offs depend on the changes and the initial shape of the curve over its whole length.

The Asian Development Bank uses a less binding definition in *Asian Development Outlook 2012*: ‘Broadly, inclusive growth can be defined as “growth coupled with equality of opportunity,” and it needs three policy pillars: sustained growth to create productive jobs for a wide section of the population; social inclusion to equalize access to opportunity; and social safety nets to mitigate vulnerability and risks and prevent extreme poverty.’ This seems to be a more pragmatic approach. It eschews a single figure, which is clearly a major drawback if one is seeking to quantify inclusivity, but it does capture the sort of factors that enter the average person’s idea of what is sensible and fair.

For Asian countries the focus on inclusive growth is essentially a focus on inequality, and this begs the question—inequality of what? There are at least three interpretations in research and policy discussions, and I will deal with each of them at least briefly.

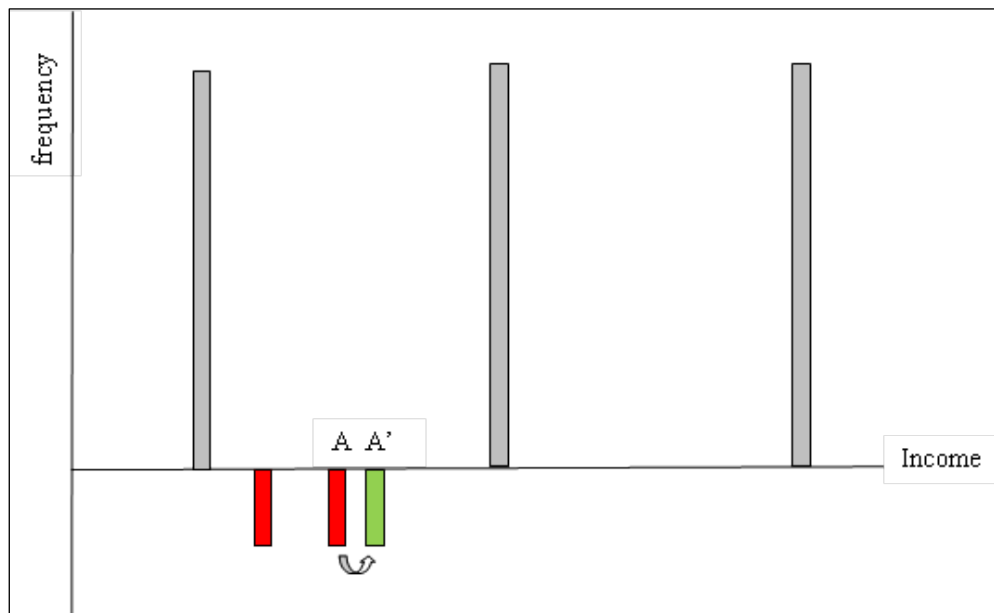
First there is the functional distribution of income between labor and capital or, by extension, between different kinds of labor, i.e., wage relativities. This lies at the heart of the debate over international trade and inequality and has also figured in considerations of infrastructure. Pi and Zhou (2012), for example, have recently shown how complex this relationship can be in theory; it depends on the substitutability of different types of labor and infrastructure (which obviously differs by type of infrastructure) and the structure of labor markets.

Second, one might be concerned about spatial inequality. The new economic geography arose from the international trade community as scholars sought to understand the implications of the regional liberalization of trade, e.g., Krugman and Venables (1990). It recognizes that the combination of fixed costs and trading costs can give rise to forces of agglomeration which cause economic activity to cluster and incomes to become unequal geographically. The provision of infrastructure for international trade is critical in this view because it determines trading costs. There may also be issues surrounding the location of 'local' infrastructure, such as water or sanitation plants.

Third, the term 'inclusive growth' applied at the country level is usually taken as referring to the personal distribution of income. While each of the previously noted dimensions obviously plays a role in this, our usual indices of inequality (Gini coefficients) are not decomposable in a way that allows the components to be identified precisely. Moreover, factors other than wages or location may also influence household incomes and could dominate them—for example, where households have multiple earners or have non-labor sources of income such as remittances.

An important dimension of the personal distribution of income is the level at which the criterion of equalization is applied. It is perfectly possible—as we will see below in some of the infrastructure examples—that policies that are unequalizing at the local level are equalizing at the national level. Imagine a country with two regions in which a policy is applied that affects only the smaller and poorer region. It may raise the incomes of only the richer people in that region and hence be unequalizing in that domain, but by moving the average income of the region toward the national average, be equalizing at the national level. Figure 1 illustrates the case in a schematic way. The larger and richer region is illustrated above the line, with three blocks of income, and the smaller and poorer is illustrated below, with two blocks of income. If the policy moves the block of incomes A to position A', it clearly spreads incomes more widely in the latter region. However, given that the national average is hardly changed, the fact that A' is closer to the national average than A means that national inequality is reduced by the policy.



**Figure 1: Locally Unequalizing but Nationally Equalizing Policy**

Source: Author's calculation.

### 3. INTERNATIONAL TRADE AND INEQUALITY

Globalization in the guise of international trade has been a force for immense good in terms of aggregate output and income—see, for example, the survey by Winters (2004) on more recent literature. The gains from trade, however, rely on exploiting differences—mainly between countries, but also within economies. International trade breaks the rigid equality between a country's production and consumption baskets that autarky imposes and so is bound to affect the relative scarcity value of different factors and different skills.<sup>1</sup> People who contribute significantly to producing goods (and services) that are valuable in the rest of the world will now encounter higher demand for their services and hence have higher incomes, while those whose endowments or skills equip them better to produce goods that compete with goods imported from the rest of the world are likely to lose relatively. The effect of international trade and trade policy on income distribution depends critically on the mechanisms through which these effects are mediated and the extent to which people can switch from a losing set to a winning one.

The combination of the words trade and income distribution causes the economist to reach instinctively for the Stolper-Samuelson theorem. Neo-classical trade theory assumes that factor supplies are homogeneous and fixed and that wages are flexible. In a two factor world, Stolper-Samuelson predicts that an increase in the price of the good that is labor-intensive in production will increase its production, increase its demand for factors of production (which, by assumption, is biased toward labor) and thus increase the real wage. More recently, Adrian Wood (1997) has taught us to think more in terms of the two factors being skilled and unskilled labor, with capital mobility sufficiently high that we can treat it as endogenous. In this case the key differences between goods are their relative intensities in skilled and unskilled labor. For many

<sup>1</sup> If it did not, there would, at least in simple models, be no gains from trade.

years we watched East Asia's opening up with its booming exports of manufactures and rapid income growth among workers with basic skills and felt vindicated. There were few formal tests, however, Fukase (2013), who considers skilled and unskilled labor in Viet Nam, has shown that the theory's basic insight is robust. Bourguignon and Morrisson (1989) made use of the neo-classical building blocks in their empirical demonstration that countries with high endowments of natural resources and high land concentration and with high levels of protection against imports tended to have less equal distributions of income.

On the whole, however, life has not been kind to Stolper-Samuelson. Partly the problem is theoretical: the theorem is less powerful in multi-commodity, multi-factor, models, and the functional and personal distributions of income are only loosely related; partly it is practical: how do we define different factors (and even goods); and partly it is empirical: in most developing countries over the last quarter century we have seen wage premiums widening, with less-skilled workers getting left behind. Many explanations have been advanced for this last phenomenon. Winters, McCulloch and McKay (2004) documented research suggesting several explanations, including:

- the initial structure of tariffs in many Latin American countries protected unskilled workers, so it is hardly surprising that liberalisation reduced their wages relatively;
- the entry of large labor abundant countries into world markets (especially the PRC) in the 1980s and 1990s, which meant that most developing country liberalisers were not actually unskilled labor abundant;
- the liberalisation of capital goods imports, which have high skills requirements;
- a burst of skill-biased technical progress in the 1980s and 1990s;
- outsourcing: while the labor that outsourced processes or firms require is unskilled by, say, US standards, it is relatively skilled by local standards;
- exporting requires quite a large volume of skilled labor, e.g., to meet standards or quality requirements or for co-ordinating tasks as might be required to be part of a global value chain.

More recent research has suggested reasons for growing inequality residing in differences between firms and has focused partly on explaining why a large part of the effect of trade liberalization seems to happen *within* sectors. Models of heterogeneous firms, stemming from Melitz's (2003) seminal work, have shown that firms are not equally affected by opportunities to trade, and that when we add heterogeneous workers we can start to see how trade liberalization may change relative wages.<sup>2</sup>

One strand of work emphasizes how trade shocks change the workforce composition or the returns to worker characteristics, but assuming competitive labor markets in which workers with the same characteristics receive the same wage. Verhoogen (2008) introduces quality-upgrading into the heterogeneous firm model. Firms that produce higher quality goods also need a higher quality workforce and need to pay higher wages to retain them; trade liberalization allows the stronger firms to expand in size and/or number, and this increases the relative demand for higher quality labor. Verhoogen tests the theory using Mexican plant level data and the Mexican peso

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<sup>2</sup> Much of this work is on Latin America. Partly this reflects that region's struggles with income distribution, but also the abundance of good data.

devaluation of 1994 as a proxy for trade liberalization, comparing the peso devaluation period, 1993–1997, with the more stable period 1997–2001 which he terms the “placebo” period. Verhoogen shows that higher productivity plants have higher export shares, pay higher wages and have a higher ratio of white- to blue-collar workers, and that these effects were stronger during the peso devaluation than in the 1997–2001 placebo period.

An important feature of Verhoogen’s results is that both blue-collar and white-collar wages increase, so that trade is aiding everyone’s income growth, just to a different extent. Frias et al. (2012) find a similar outcome: they look at the effect of exporting on the within-plant wage distribution using employer-employee data for Mexico and a similar identification strategy to Verhoogen’s (2008). They find that exporting is associated with higher wages on average but that when disaggregated by quantiles of the *within-firm* wage distribution, there is no evidence of an impact of exporting at the tenth percentile while the effect is significant and increasing at higher percentiles.

Bustos (2011) studies Argentina, as the implementation of Mercosur led to differential reductions in Brazil’s tariffs across sectors. She allows firms not only to have different productivities but to choose technologies as well. In equilibrium there are three types of firms: the skill-intensive exporter, the unskilled exporter, and the unskilled domestic-only firm. A tariff reduction in an export market induces more firms to enter and upgrade to the skill-intensive technology and increases the market share of more productive firms. This generates higher demand for skilled workers and increases the skill premium. The least productive firms, on the other hand, are instead forced to downgrade skill. Bustos does not consider wages directly, but finds that the net effect of Mercosur on the share of skilled labor is positive and explains one third of the increase in the employment share of skilled labor in Argentina between 1992 and 1996.

The second strand of research focuses on labor market frictions as the explanation for increasing wage inequality across firms and individuals even within a single sector or occupation. Fair wage models, efficiency wages models, and match and search frictions models have all been suggested recently as plausible explanations for differences between workers. The main implication of these models is that not only can the composition of the workforce change differentially across firms following trade liberalization, but also that workers with identical characteristics can be paid differently according to the trading status of their employer. This happens because of the link between wages and firm revenues implied by the labor market assumptions.

Helpman et al. (2010) develop a model of heterogeneous firms where the labor market is characterized by search and matching frictions. In this framework, firms have an incentive to screen workers in order to select those with high abilities. More productive and larger firms screen more intensively and thus have a workforce with higher average ability and higher wages (because they are more difficult to replace). Trade liberalization, which generates an expansion of more productive firms able to enter the export market, also increases their capacity to screen workers and select those of higher ability, and results in their obtaining better works and paying higher wages<sup>3</sup>. Helpman et al (2012) test this model using matched employer-employees Brazilian data between 1986 and 1995. They first show that consistently with the model the data displays four main features: first, most of the wage inequality is due to within sector-

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<sup>3</sup> A second implication is that the relationship between wage inequality and trade costs is first increasing and then decreasing. This is because the driver of wage inequality in this model is the share of exporting firms. At the two extremes of zero exporting firms and all exporting firms, wage inequality is unchanged.

occupation wage inequality; second, residual wage inequality explains a large part of total wage inequality; third, between-firm wage dispersion accounts for a large part of the growth of within sector-occupation wage inequality; and fourth, larger firms and exporters pay higher wages on average.

In a note of caution, however, Krishna et al. (2011) further probe the role of compositional changes in the workforce of exporting firms in response to liberalization. Their hypothesis is that firms may systematically change the composition of their workforce in terms of workers innate ability and/or firm-worker match-specific ability, neither of which is observable to researchers. If that is the case, analysis looking only at the average firm-level wages may be biased. Thus while some researchers attribute the higher wages paid by exporters to the fact that exporters pay different wages to otherwise identical workers, the reality may be that there are systematic but unobservable compositional differences between firms. Krishna et al. test the hypothesis of non-random workers assignment using Brazilian matched employer-employee data. They show that, once controlling through worker-firm match effects for the endogeneity of the worker-firm matching, there is no significant effect of lower tariffs on wages on both domestic-oriented and exporting firms.

Amiti and Davis (2011) extend the heterogeneous firm model to separate trade in final and intermediate goods and also to embed a fair wage model of wage determination which ties firm wages to firm performances. The model predicts that lower tariffs on final goods increase the wages of workers at exporting firms while reducing wages of workers at domestic-oriented firms. Lowering input tariffs, on the other hand, raises wages at importing firms but reduces wages at firms that do not import any inputs. They test the model on Indonesian firm data for the 1991–2000 period of trade liberalization and find that a 10 percentage point reduction in output tariffs increases wages by up to 3% in exporting firms but reduces wages by 3% in domestic oriented firms. (If workers are already sorted by type of firm – e.g. more skilled in export sectors – this would translate into a functional distribution result.) A 10 percentage point reduction in input tariffs increases wages by up to 12% in importing firms but has an insignificant effect on firms that do not import. The results are consistent with a fair-wage mechanism that translates firms' heterogeneity in the impact of trade liberalization into workers' wages. However, given data limitations it is not possible to distinguish this effect from effects deriving from compositional shifts in the workforce or changes in the unobserved worker characteristics following trade liberalization.

While the above studies tend to reveal that trade liberalization increases intra and inter-sectoral wage inequality, Amiti and Cameron (2012) reach a different conclusion for Indonesia. They look at the impact of trade liberalization on the within-firm wage skill premium distinguishing between reductions in input tariffs and in output tariffs. They use industry variation in tariffs over time to identify the causal effect of tariff reductions on the wage skill premium paid by firms. They find that reducing input tariffs actually reduces the wage skill premium while there is no significant effect from reducing tariffs on final goods. These results arise because intermediate inputs production in Indonesia has higher skill intensity than final goods production—an almost pure Stolper-Samuelson result. Their explanation for this finding in contrast with most of the literature is that Indonesia is one of most unskilled-abundant country while most of the previous studies have focused on middle-income countries with a relatively lower concentration of unskilled labor.

These models are very exciting from a theoretical point of view. Their potential for policy, however, relies on household incomes being related to relative wages in a simple way—an assumption that the possibility of multiple earners and multiple jobs for one earner frustrate. Moreover, many poor people earn their livings not from wages in

the labor market, but by making and selling goods or services. Thus one should be careful not to extrapolate these models too far into the territory of inclusive growth.

The key factor in the models above is labor immobility – the inability of labor with lower wages to move into jobs offering higher wages. This immobility might reside in any of several dimensions, such as:

- skills—the distinction between skilled and less skilled workers;
- geography—which may relate to migration costs or information failures;
- hiring and firing costs—which may prevent firms from turning over their workforces;
- the gradual accumulation of firm-specific or sector-specific knowledge, so that incumbent workers are *ceteris paribus* better value;
- search and match processes in which firms and workers face costs of changing their pairing; or
- convention or discrimination that limit labor market matches.

In the absence of any such immobility labor could move freely between sectors and tasks and we would expect to see wages equalized over much broader spaces. Thus if there is a policy conclusion from this stream of work, it is that labor immobilities lie behind much of the unequal effect of opening up international trade. However, even with perfect mobility, different skills would persist and so wage inequality would reside—as has been found in Latin America—at least partly in the returns to education. If these are high—i.e., there are large wage differences between skilled and unskilled workers—and if the acquisition of education is subject to biases of geography, class or race etc., inequalities will still be unfair in a broad sense and hence a legitimate target for policy intervention.

Labor mobility depends on many factors, but prominent among them are institutions. Labor law is clearly one such institution, but others include areas such as pension and social security, access to education, housing institutions. Also important are attitudes toward equality within government and the body politic. International trade is redistributive and governments that are willing to consider policies that ease the plight of those who suffer are likely to find their populations much more willing to countenance and respond to change than others. The USA's experience with trade-specific adjustment assistance has been disappointing—see, for example, McCulloch et al. (2001) for a discussion in the context of poverty—and more general social security measures may be more appropriate.

One reservation to all this must be recorded. If labor is geographically mobile, neo-classical theory would predict the equalization of wages across space. However, if the world resembles that postulated by the new economic geography scholars, labor mobility can exacerbate regional inequalities such that people who are left behind in the unfashionable parts of an economy suffer considerable real wage disadvantage. I return to these issues below under the heading of infrastructure.

An inequality not amenable to mobility is gender. A number of studies have examined the effects of trade liberalization on gender disparities and in most cases found that trade is equalizing. One can distinguish three main routes for such benefits. First, if trade liberalization favors female-intensive sectors, female wages or employment will increase. Aguayo-Tellez et al (2010) look at the impact of tariff reductions caused by the NAFTA on gender outcomes in Mexico. They decompose the change in the female share in employment and wage bill into the between and within-industry components.

Women's share of the wage bill increased by 5.3 percentage points between 1990 and 2000, 40% of which was accounted for by between-industry shifts caused by tariff changes favoring initially female-intensive industries.

Second, trade can affect the within-sector gender composition. As noted above, trade liberalization stimulates more productive firms and higher quality products. This frequently entails skilled and cognitive tasks replacing unskilled and manual tasks and may also involve technological upgrading. This can affect gender labor market outcomes if women have a comparative advantage in less physically intensive and higher skilled activities. Juhn et al. (2013) again examine Mexico in NAFTA and find that tariff reductions induced the entry of new firms into the export sector, that the newly exporting firms upgraded their technology, particularly with new computerized equipment, and that the tariff reduction increased the ratio of female to male blue-collar workers as well as the relative wage of female blue-collar workers. They find no effect in white-collar occupations, where the brain vs. brawn trade-off is not relevant.

Third, there is gender discrimination, which Becker (1971) predicted would fall as competition increased. Ederington et al. (2010) use plant level data to analyze the impact of Colombian trade liberalization on the share of female workers employed in Colombian plants. They find that establishments experiencing a greater decline in tariff protection increased their share of female employees. The effect is due not to the exit from the market of discriminating firms but to plants hiring more women.

As noted above, the possibility of multiple earning households makes the translation of these results into household level inequality treacherous. However one study has attempted to look at trade and household level inequality directly. Milanovic (2005) uses a dataset of spells between household surveys in developing countries to explore the effects of openness on the whole of the distribution of income. He finds that, for poorer countries (below around \$8,000 p.a. at international prices), openness is unequalizing (i.e., higher incomes grow by more than lower ones). He cannot determine the cause of this but presumably it reflects the possibility that the richer members of society are better placed or better equipped to take advantage of the opportunities that increased international trade offers. This may reflect their political connections to grab opportunities or to influence the details of liberalization or it may reflect genuine differences in skills and/or resources. Above the threshold, openness is apparently equalizing, perhaps because its ability to curb market power is more important where incomes are higher.

## 4. INFRASTRUCTURE AND INEQUALITY

I will consider two possible routes through which infrastructure could affect inequality. The first is because it fundamentally determines the costs of trade and hence the gains from trade. These could as well be internal as international. Trade is fundamental to raising incomes above subsistence level, but as noted above the ability to take advantage of it is not conferred equally on all citizens. Second, infrastructure has local effects—often only local effects, e.g. water supplies—and so location and access to facilities are a critical dimension.

An elegant exercise bringing infrastructure and the gains from trade together is Donaldson (2010), on the effects of the enormous expansion in transportation infrastructure implied by the construction of colonial India's railway network. His exercise is explicitly located in a theoretical model of the inter-regional trading environment whereby railways reduced the cost of trading which he shows resulted in increased trade volumes and reduced inter-regional price differences. He estimates

that when the railway network was extended to the average district in colonial India, real agricultural income in that district rose by approximately 16% and several additional tests make this a credible estimate.

Similar estimates have been made for the growth of the PRC's highway system since about 1997, the location and timing of which offers economists ample opportunities to identify the effects. Roberts et al. (2012) use a 'classical' new economic geography model to tackle the question, based directly on the models of Fujita, Krugman and Venables (1999). Having located the highway network they calculate the time savings (improvements in market access) on different regions' trade that it implies, and from this they estimate the changes in the real wage that can be supported in those regions. Comparing scenarios with and without the network, they can estimate the network's effects—at least in the relatively short-run. There has not been sufficient time to estimate the long-run effects, but it is also true that these would be more complex because of the possibilities of population movements and other long-run adjustments.<sup>4</sup> Specifically they consider rural and urban real wages and, by summing them up, changes in national income. They estimate that the expressway network increased Chinese real income by 6% p.a. in the short run. They also find, however, no tendency for rural–urban disparities or disparities between different prefectures to narrow. This analysis confirms the neo-classical presumption that improved connectivity will be good for both parties, i.e., that rural areas benefit from being connected to urban ones.

A related approach to the highway network in the PRC is by Faber (2012). He focuses on heterogeneity between cities and finds that the highway network allowed an agglomeration of industry that actually harmed peripheral regions, reducing their incomes by 13% on average. The mechanism he exploits is the home market bias that has long been observed in internal and international trade coupled with economies of scale. This combination implies that larger regions can have lower costs and hence higher incomes.

Zheng and Kuroda (2013) also use economic geography to explore the role of road, educational, and telecommunications infrastructure in explaining growth and dispersion across cities in the PRC. Taking pairs of cities, Zheng and Kuroda seek to explain differences between their shares of manufacturing in GDP and their shares of the national wage bill and also their combined GDP growth rates. Road links between cities boost their combined growth and narrow the differences between their wage bills, but exacerbate differences in their manufacturing shares. Educational infrastructure refers to tertiary institutions, which along with telecommunications infrastructure are held to stimulate knowledge interchanges between cities. Together these are shown to not only to boost combined growth and narrow wage bill differences, but also to cause manufacturing shares to converge.

The bulk of this work suggests that while major transportation infrastructure programs may be good for aggregate growth, they are also potentially bad for inequality. When two centers are linked there is a tendency for the initially stronger center to benefit more than the weaker. This will usually lead to a widening of income gaps, although this is not absolutely inevitable as the larger economy may have lower incomes per head, for example. Nonetheless, the potential for transportation infrastructure to be unequalizing is obvious, and for policy makers concerned with inclusive growth this is an important issue. From a policy point of view these findings do not suggest that large scale transportation programs should be abandoned, but rather that it should be

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<sup>4</sup> Banerjee, Duflo and Qian (2012) estimate the longer-run benefits of connection in general in the PRC (not just roads) and find them to be positive.

recognized that if one is intent on not increasing disparities, significant investments in complementary policies are likely to be necessary.

Of course, most transportation infrastructure investment is at a much more modest scale than the PRC's highway network. There is a long tradition in development economics of investigating the benefits of rural roads in terms of allowing farmers to reach new markets and to consume new goods and services. The greater relative importance of local over national roads in poor countries is illustrated by Fan and Chan-Kang (2008) who suggest that for the PRC in the late 20th century, the benefit-cost ratios for the former are larger than those for the latter by a factor of over four.

Khandker and Koolwal (2010) address infrastructural issues in rural Bangladesh, using a pooled dataset of three household panels from 1991 to 2001. They consider the expansion of irrigation, paved roads, electricity, and access to formal and informal credit, all of which have been aimed at raising the income and consumption for the rural poor. They examine how these interventions have contributed via wage and self-employment activities across both the farm and non-farm sectors and, in particular, how the poor have benefited from them. Most of the interventions contributed to farm or non-farm income growth and, in particular, tended to enhance growth in self-employment income relative to wage earnings. The strongest effects appeared to be via interventions that lowered input costs, such as transport costs and wages for hired labor. One cautionary note emerges from this work, however. While infrastructure expansion raised per capita expenditure for most households, this was not true for households in moderate poverty (those at the 20th percentile of income). For this group, only micro-credit seemed to be effective.

The same authors, Khandker and Koolwal (2011), offer an interesting extension of this exercise, extending the time period and looking at the evolution of benefits over time and at a slightly broader menu of potential benefits. They find that many of the effects on household per capita expenditure, school enrollment, and transport costs, do indeed attenuate over time. But not all: non-agricultural wage employment seems to rise by more for households with longer experience of better roads. This, the authors suggest, reflects either a feedback link between off-farm work and rural road development, where road improvements foster markets that become increasingly diversified across sectors, or that improved school enrollment, probably associated with better access to schools, is generating a higher demand for labor in the long run.

The newer study reinforces the previous result that the distributional impacts of rural road investments are not wholly benign, which is also an important policy concern. The results indicate that the initially poorest quartile of households did not share in the benefits of rural roads; the next quartile up appeared to receive positive gains, but the main beneficiaries were the third quartile. Khandker and Koolwal speculate that it is households in the middle of the distribution that may be the most mobile in terms of changing sectors of activity away from agriculture and toward non-farm work. The very poorest households just may not be as able to capture the cost and productivity benefits of road projects.

A further significant result for policy makers is that the most important aspect of rural roads for generating benefits, including those of asset accumulation, appears to be road quality. This clearly points up the importance of institutions surrounding the road-building program. It is well understood that procurement failures frequently undermine road programs, not least by providing sub-standard roads.

A slightly more encouraging view of the distributional impact of rural roads comes from Mu and Van de Walle (2011), who assess the impact of rural road rehabilitation on market development at the commune level in rural Viet Nam. Their results suggest



significant impacts on the development of local markets and the provision of local services, with households switching from agriculture to non-agricultural, mostly service-based, activities and an early and sustained increase in primary school completion rates. The impacts are heterogeneous, however; poorer communes tend to report higher impacts due to their lower levels of initial market development (there is more room to make up), but are disadvantaged by having fewer market institutions initially on which to build. The exact balance of these forces is what determines relative outcomes, with distance to central markets, low population density, large minority populations, high adult illiteracy, and being location in the North all consistently dampening the road's positive impacts. Mu and Van de Walle suggest that small road improvement projects could have 'vastly larger' impacts on local market development if they were targeted to places with initially lower market development, and if accompanied by complementary social and economic policies designed to improve certain attributes (such as adult literacy) or reduce the disadvantages of others (such as policies to reverse the effects of historical discrimination toward ethnic minority groups).

The unequalizing effects of local roads are replicated in Africa as well. See, for example, Najman, Gachassin, and Raballand (2010), on Cameroon, who argue that an increase in non-farming activities is the main driver for poverty reduction in rural Africa, and conclude that the priority in road investments should be for locations where non-farming activities could be developed, not the so-called 'last mile' in rural areas. Similarly, Bryceson, Bradbury and Bradbury (2008), on Ethiopia, Zambia, and Viet Nam, suggest that in extremely remote areas, road improvements may catalyze the expansion of social-service provision, as evidenced in Ethiopia, but also that given the poor's relative lack of motor vehicles and inability to pay for public transport, roads are, by no means, a sufficient condition for enhancing the mobility—and hence the economic fortunes—of the rural poor.

The central theme of this brief discussion of infrastructure is, as with international trade, mobility. Infrastructure, like trade, opens up opportunities and the main gainers will be those who are able to take advantage of them either through good luck, (as they happen to be in the right sector or place), inherent abilities, or through having access to necessary complementary factors. Often this will require movement between regions or sectors or even firms, and factors that inhibit this are likely to impede or prevent the spread of the benefits of an infrastructure investment program.

On access to infrastructure, Estache and Fay (2007) show that access to intra-regional infrastructure is highly skewed against the poor; see their Table 4, reproduced below as Table 1 below. It looks at the top and bottom quintiles in three groups of countries. Estache and Fay note that there are issues both of physical access and of affordability. On the former, the issue is where infrastructure is built, which depends substantially on political influence, and once it is built, who can afford to live close by to it. The latter means that even if, say, piped water is close-by, the poor may still need to pay service charges to get at it and these may be prohibitive. Indeed they argue that for the poor, affordability is a major hurdle and will almost certainly require public subsidy in some form or other.

**Table 1: Access to Infrastructure by Income Quintile**

<b>Table 4. Access to infrastructure services by richest and poorest 20 percent of the population (% of population receiving services)</b>								
	Electricity		Water		Sanitation		Telephone	
<i>Country grouping according to Income level</i>	<i>Poorest 20%</i>	<i>Richest 20%</i>	<i>Poorest 20%</i>	<i>Richest 20%</i>	<i>Poorest 20%</i>	<i>Richest 20%</i>	<i>Poorest 20%</i>	<i>Richest 20%</i>
Low	9.7	68.7	41.1	78.5	27.2	68.8	3.2	24.5
Lower-middle	79.5	99.3	64.5	86.6	48.2	78.7	21.2	66.1
Upper-middle	81.4	99.5	76.7	95	73.4	96.4	32	73.1
<i>Source: Briceño and Klytchnikova (2006)</i> <i>Note: Data are the most recent available for 2000–04.</i>								

Source: Estache and Fay (2007).

One telling example of problems with access is Raballand et al. (2011), who offer evidence on access to services from a randomized experiment in Malawi. In order to understand why roads in relatively good condition in rural areas might not be used by buses, a minibus service was subsidized over a six-month period over a distance of 20 kilometers to serve 5 villages. Using randomly allocated prices for use of the bus, the experiment showed that at very low prices, bus usage was high, but that it decreased rapidly as prices rose. Overall, however, it showed that regardless of whether the prices were low (with high usage) or high (with correspondingly low usage), the bus service provider could never break even on the road. In terms of policy implications, this experiment suggests that motorized services may need to be subsidized; and if personal transportation is the main aim of a road building or upgrading project, it is likely to be ineffective unless a complementary policy is pursued. Of course, this example is highly case specific, but the general caution is valid.

Affordability considerations in turn lead to questions of regulation. Even public utilities need regulating in the sense of defining service standards, etc., and privatized ones obviously do. These issues of distribution are highly political and closely related to issues of governance in general.<sup>5</sup> Thus, one might expect the effectiveness of infrastructure in addressing inequality (and even possibly growth) to vary with the quality of governance.

However, regulation has to be good to be of use. Teravaninthorn and Raballand (2009) look at transport prices along road corridors in Africa. They assess the likely returns to investment in each of five corridors and find that they vary significantly with the institutional situation. In particular they find that in west and central Africa, transportation costs could be significantly reduced by reducing fuel costs, improving road quality, and reducing border crossing times. However, they argue that the trucking sectors are so cartelized and heavily regulated that any cost savings produced will just go into truckers' pockets rather than stimulate trade and enterprise. The moral is that until regulation ensures sufficient competition to ensure that cost savings are passed on, road and border-crossing improvement schemes will tend to be unequalizing.

<sup>5</sup> Indeed much of the literature on the regulation of infrastructure refers to the 'governance' of the sector; see, for example, the excellent discussion in Kenny (2007). Parker et al. (2008) offer a survey of results on regulation and poverty and show that the area is really quite challenging. A key reference on regulation is Estache and Wren-Lewis (2009).

because they will increase rents. Raballand et al (2012) make a similar point about port facilities—the problem is not only inefficient officialdom but private restrictive practices.

## **5. CONCLUSIONS**

Two of the key ingredients to economic growth—trade and infrastructure—tend toward creating inequalities. Sometimes their beneficiaries are the poorest, and their effect is equalizing, but often, taking advantage of them depends on other endowments or abilities and the benefits accrue to those above (possibly just above) the bottom of the income distribution. In the context of inclusive growth, this is a problem, but the answer is not to eschew opening up the economy or building infrastructure, but to do so in an informed way and seek to undertake complementary policies that help the less well-off take advantage of them.

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