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**What Constrains Africas Exports**

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## Abstract

This paper examines the effects of transit, documentation, and ports and customs delays on Africa's exports. The authors find that transit delays have the most economically and statically significant effect on exports. A one-day reduction in inland travel times leads to a 7 percent increase in exports. Put another way, a one-day reduction in inland travel times translates to a 1.5 percentage point decrease in all importing-country tariffs. By contrast, longer delays in the other areas have a far

smaller impact on trade. The analysis controls for the possibility that greater trade leads to shorter delays in three ways. First, it examines the effect of trade times on exports of new products. Second, it evaluates the effect of delays in a transit country on the exports of landlocked countries. Third, it examines whether delays affect time-sensitive goods relatively more. The authors show that large transit delays are relatively more harmful because of high within-country variation.

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This paper—a product of the Trade and Integration Team, Development Research Group—is part of a larger effort in the department to understand how trade costs affect trade. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The author may be contacted at [cfreund@worldbank.org](mailto:cfreund@worldbank.org).

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# What Constrains Africa's Exports?

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## **I. Introduction**

Earlier work has shown that delays in getting goods from the factory gate onto the ship hinder exports more than foreign tariffs do (Hummels (2001), Djankov, Freund and Pham (2010), and Portugal and Wilson (2009)). This is especially debilitating for Africa's exports because of extreme delays. This suggests that improving trade facilitation in Africa would significantly boost exports. But there are different ways to accomplish this, as the time delay has three distinct components: documentation, transit time, and port handling and customs clearance. In this paper, we explore whether these delays are equally burdensome or whether one of these binds relatively more, using detailed data on average trade times from the World Bank's *Doing Business* report.

Bureaucratic delays are the longest, taking 19 days on average. There is a lot of variation across countries. For example, it takes 36 days to process export documents in countries such as Angola, Zambia and Niger. In contrast, in Swaziland, it takes only 5 days to produce all necessary export documents. Bureaucratic delays may be especially burdensome if they change often, making them difficult to predict, or if officials use them as a means to extract rents. In contrast, documentation procedures may be less problematic if they are predictable and can be done in advance or if there is learning by doing.

Customs and ports delays are the second longest, taking on average 9 days. They are less variable than documents. Customs and ports could be especially restrictive if there is a hold-up problem. Once the goods arrive, customs and port authorities could extract high rents by delaying goods. In contrast, if customs and ports are reliable (but slow) or if exporters can pay for faster service they may cause fewer problems.

Transit costs are on average the shortest, taking 7 days. But, again, there is a lot of variation. For example, it takes 37 days for the goods to be shipped from Bujumbura (Burundi) to Dar Es Salaam port (Tanzania) and only one day within Gabon. Transit costs may be less burdensome if economic activity has developed endogenously, close to ports and borders when transit costs are large. However, they may be more constraining if there is a lot of uncertainty that cannot be avoided.

The main contribution of our paper is to understand whether different types of export costs affect trade differently. We use a modified gravity equation that controls for importer fixed effects and exporter remoteness. An important concern with this approach is that the volume of trade may directly affect trade costs. The marginal value of

investment in trade facilitation is higher when trade volumes are large since cost savings are passed on to a larger quantity of goods. In addition, many time-saving techniques, such as computerized container scanning, are only available in high-volume ports. Alternatively, increased trade volumes could increase congestion and lessen the efficiency of trade infrastructure. Thus, while more efficient trade facilitation may stimulate trade, trade is also likely to directly influence trade facilitation.

We use three distinct strategies to deal with the potential effect of export volumes on export times. First, we examine the effect of trade facilitation on trade in new products. These are goods that have not been exported in the past. The intuition is that trade in new products cannot affect the quality of trade facilitation infrastructure or the bureaucracy that is in place for exporting. Second, we examine the effect of requirements in the transit country on exports from landlocked countries. This controls for endogeneity because trade facilitation in transit countries is likely to be exogenous from the perspective of a landlocked country. Finally, we test whether lengthy delays have a greater effect on exports of time-sensitive goods. The intuition is that these products make up a small share of total trade so are unlikely to affect trade facilitation.<sup>1</sup>

All three different techniques used to analyze the effect of export times of key components on trade values lead to the same conclusion: inland transit delays have a robust negative effect on export values. Our estimates imply that a one day increase of inland transit times reduces export values by about 7 percent. This effect is higher for time-sensitive goods with respect to time-insensitive goods. In contrast, we do not find a robust effect of documents or customs and ports on exports.

Why would delays in one area affect trade relatively more than in other areas? One potential answer is uncertainty. To the extent that delays are anticipated there should be only a small effect because documents can be prepared in advance and goods can be shipped early, with ample time for meeting deadlines. To evaluate this explanation, we examine the effect of within country export-time uncertainty for each type of delay on export values. Again, we find that an increase in inland transit time uncertainty has a negative and significant effect on trade values. The other time components show no such effect. This suggests that long and unexpected delays in transit make it especially difficult for producers to meet import deadlines.

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<sup>1</sup> The second and third strategies follow from Djankov, Freund, and Pham (2010).

Our results have important implications for policy. While reducing bureaucratic delays and improving ports and customs may have small positive effects on trade, the binding constraint in most African countries to expanding exports is inland transit. Improving inland transit is unlikely to be easy or cheap, but it is likely to boost exports and have broad positive economic effects.

Beyond these direct implications for policy, our results also contribute to the broader debate about the influence of geography versus institutions on income. This literature has focused on the effects of climate versus governance on income, and potential interactions between the two.<sup>2</sup> We focus on a single component of income, exports, and our variables of interest reflect geography and institutions to different extents. The dominance of transit time in hindering exports seems to suggest that geography is the main culprit. To test this, we gather data from a GPS system on geographical distance from the port to the economic center and the estimated time of travel and include them in the regression equation. The difference between travel time in the GPS data and the *Doing Business* data is that the former are based solely on travel distance and estimated speed of travel by type of road (paved or unpaved). These data do not incorporate delays due to average vehicles, borders, security, traffic, or other road conditions. We find that GPS distance negatively affects exports, but GPS travel time does not. Moreover, neither the economic effect nor the statistical significance of the *Doing Business* inland transit time variable changes when these variables are included. This suggests that the problem for inland transit lies in the quality and security of the roads, border delays and the efficiency of security checkpoints, the age of the truck fleet and competition in trucking. These are factors which are more closely linked with institutions than geography.

The paper proceeds as follows. The next section discusses the data. Section III presents the estimation strategy. Section IV describes the main results and robustness checks. Section V examines the effect of uncertainty on exports and the importance of geography. Section VI concludes.

## **II. Data**

We use data on trade times based on answers to a comprehensive World Bank questionnaire completed by trade facilitators at freight-forwarding companies in 146

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<sup>2</sup> See, for example, Hall and Jones (1999), Acemoglu, Johnson, and Robinson (2000), and McArthur and Sachs (2001).

countries in 2007 and collected as part of Doing Business, a World Bank project that investigates the scope and manner of business regulations<sup>3</sup>.

The data provide detailed information on the different kinds of costs an exporter faces when moving his goods from the principal city to the port of exit. More precisely, the survey asks respondents the average and the maximum times in calendar days it takes for completing a series of export procedures. Each procedure can be classified into one of four main categories: documentation, inland transportation, customs, and ports.

The first category represents the time it takes for an exporter to complete all documentation activities such as securing a letter of credit, assembling and processing export and international shipping certificates and realizing all pre-shipment inspections and clearance.

Inland transportation includes the time it takes for the merchandise to be moved from the principal city to the port of exit, as well as the time spent arranging transport and waiting times for the merchandise's pick up and loading into a carriage. For landlocked countries, total transport times also include waiting times at the crossing border.

The customs category includes the time necessary to realize the technical controls of the merchandise. In addition, for landlocked countries this category comprises the total time it takes from the submission of request of clearance until the completion of the inspection and clearance procedure in the transit country. Finally, the ports category represents terminal handling times, including storage if a certain storage period is required, the waiting times for loading the containers into the vessel and customs inspection and clearance times.

An example illustrates the data. An exporter in Rwanda spends 43 days on average to complete all requirements for shipping its merchandise abroad: 17 days each on delays resulting from documentation and inland transit, while port and custom procedures take respectively 6 and 3 days on average (see Figure1).

Table 1 presents the summary statistics for each of the components representing the total time<sup>4</sup> necessary to fulfil all the requirements for exporting by region and regional arrangement. The data show that across regions, documentation procedures times are the longest. Furthermore, while getting a product from the factory to the ship is relatively quick in developed countries, this is not the case for Sub-Saharan Africa, where all time

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<sup>3</sup> For a detailed description of the data see Djankov, Freund and Pham (2010).

costs categories are on average higher compared to all the other regions. Customs and ports procedures and inland transportation take on average three times more in Sub-Saharan African countries than in OECD countries. In addition, documentation procedures take four times more in Sub-Saharan countries compared with developed countries.

The rest of the data are from standard sources. The trade data are both from the UN Comtrade database and the IMF Direction of Trade database. GDP and Population are from the World Bank's World Development Indicators. Gravity variables such as country pair distances, language and colony are taken from the Mayer and Zignago dataset. Country's Capital abundance information is available for 2005 and comes from GTAP 7 database. Simple average Tariffs at 6 digit level are taken from the TRAINS dataset.

### III. Methodology

We investigate how three diverse trade costs---completing documentation, inland transit delays, and customs and ports times---affect Sub-Saharan Africa trade volumes. Longer time delays act as a tax on exports, especially on high-value goods, since they are effectively depreciating during the delay. In addition, the exporter must spend capital on the exporting process and storage/transport of the goods during the delay.

We begin by estimating the augmented gravity equation:

$$\begin{aligned} \ln Exports_{ij} = & \beta_1 \text{Inland transit}_i + \beta_2 \text{Customs \& Ports}_i + \beta_3 \text{Documents}_i + \beta_4 \ln GDP_i + \\ & \beta_5 \ln Pop_i + \beta_6 \ln Dist_{ij} + \beta_7 \ln Remote_i + \beta_8 \text{landlock}_i + X_{ij} + \mu_j + \varepsilon_{ij} \end{aligned} \quad (1)$$

where the  $i$  and  $j$  subscripts correspond to the exporter and the importer, respectively.<sup>5</sup> The dependent variable represents bilateral exports from country  $i$  to country  $j$ . The variables of interest are the export times for transit, customs and ports, and documents. The coefficient on each represents the effect in percent of trade of a one day increase in that component. We focus on variables in levels, so that the coefficients are

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<sup>4</sup> The time delays reported in the survey are probably at the lower end of the time it takes to move the average product from factory to ship. This is because the products are chosen so that they do not require cooling or any technical inspections based on use of hazardous materials.

<sup>5</sup> The times representing terminal port handling and customs and technical control were aggregated due to their very high correlation. (See Table 2)



comparable—the effect of a one day change. However, for robustness, we also estimate the regression with the three variables in logs. We also include the standard determinants of trade in the regression equation:  $\mu_j$  are importer fixed effects which control for the extent to which the importer is isolated from the rest of the world;  $GDP_i$  and  $POP_i$  are respectively the Gross Domestic Product and the total population of country  $i$ ;  $Dist_{ij}$  is the distance between country  $i$  and country  $j$ .  $X_{ij}$  is a vector of dummy variables associated with the exporter and the importer such as sharing the same official language or border or past colony/colonizer relationship.  $Landlock_i$  is a dummy variable equal to one if the exporter country is landlocked and zero otherwise.  $Remote_i$  is a measure for the exporter's remoteness and is calculated following Head (2003),

$$Remote_i = \frac{1}{\sum_j GDP_j / Dist_{ij}} .^6$$

There is a potential reverse causality problem in our regressions because time-to-export variables are likely to be correlated with country exports. An improvement of infrastructure and administrative time costs has positive effects on exports. However, countries that export more may have higher returns to enhance local trade facilitation and invest more in time efficient means. In addition, some types of exports processing might only be available in high volume ports. Hummels and Skiba (2004), for example, provide evidence that trade volumes affect the timing of adopting containerized shipping and reduce shipping costs. Finally, it might be the case that in countries with higher volumes of trade, export procedures will be affected by congestion effects. In this case the presence of reverse causality will lead to an underestimation of the coefficient on time costs.

To control for the possibility that more trade leads to improved trade facilitation, we investigate the effects that documentation, inland transport, and customs and ports times have on the exports of new products.<sup>7</sup> The intuition is that exports of new products cannot

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<sup>6</sup> It is important to control for remoteness in our regressions for two reasons. First, there is evidence that a country's trade with any given partner is dependent on its average remoteness to the rest of the world (Anderson and Van Wincoop (2003)). Furthermore, remoteness is correlated with factory-to-port time delays hence not including it into the regression would produce biased estimates of the impact of trade facilitation on export volumes.

<sup>7</sup> We define new products as those that were not exported in the years 2002 2003 and 2004 and that entered into the export market in the time interval 2005-2007.

have had an impact on the historical development of infrastructure or the type of bureaucratic procedures in place. In addition, because they are a very small share of total trade they are unlikely to be associated with congestion effects. We also follow Djankov, Freund, and Pham (2010) and use trade times of transit countries as instruments for trade costs in landlocked countries and examine whether trade times affect time-sensitive goods relatively more.

#### **IV. Results**

We now estimate the augmented gravity equation from expression (1). The linear regression results for a sample of 44 Sub-Saharan Africa countries are reported in Table 3. The first column shows the results from estimation on all trade. All three variables are significant and their coefficients are similar, though it is somewhat higher for inland transit. However, this column does not deal with the problem of endogeneity of the right hand side variables. In column (2), we report results for trade in new goods only. The time variables are less likely to be endogenous to trade in new goods, since this trade was not around in the past when procedures and infrastructure for trade were developed. The results are somewhat different. While the coefficient on inland transit is little changed from column (1), the other coefficients fall considerably, suggesting that the previous column was also picking up the effect of trade on documentation procedures and customs and ports. In particular the results imply that a one day increase in transit time leads to a nearly 7 percent decline in exports.

In the next five columns, we report robustness tests. Columns (3)-(5) report the results of each variable independently and total time. This helps to deal with potential multicollinearity between the variables and also informs us whether each variable is significantly different from total time in its effect on exports. Only inland transit has an independent effect on exports. Moreover the total effect of inland transit, equivalent to 0.067 ( $0.049 + 0.018$ ), is nearly four times as large as the effect of the other components of time. This outcome holds after the inclusion of foreign import tariffs in the regression (see column (6)). Including foreign tariffs also allows us to interpret a day in terms of tariffs. A one day delay is roughly equivalent to a 1.5 percent point reduction in *all* importer country tariffs. Finally in column (7) we report results using logs of the time

variables. While a one percent reduction in total time leads to .5 percent more trade, a one percent reduction in transit time leads to about a .7 percent decline in exports. Again only transit time is independently significant (results for other variables are not reported).<sup>8</sup>

Our second strategy to deal with the potential endogeneity of the export time variables is to use a sample of landlocked countries and use the variables for the transit country(ies) as the instrument. This follows from Djankov, Freund and Pham (2010).<sup>9</sup> Results are reported in Table 4. The first column reports OLS regression results for this sample. With the exception of documents, the coefficients are much larger for this sample than for the full sample (column (1) of Table 3). One explanation is that the endogeneity problem is greater here. For example, when landlocked country trade is small, customs and ports authorities (which must be located in neighboring countries) give them the lowest priority. To control for endogeneity, we next instrument each time variable with the corresponding variable in the transit country. The F-statistics of the first stage regressions (see Table 1A of the Appendix) indicate that none of the instruments is a weak instrument.<sup>10</sup> Second stage regression results, with and without foreign tariffs, are reported in levels in columns (2) and (3) and in logs in columns (4) and (5). For landlocked countries, only inland transit has a robust negative and significant effect on trade.<sup>11</sup> Moreover, the magnitude from column (2) is similar to the result using all countries and new trade (column (2), Table 3): a one day reduction in transit delays leads

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<sup>8</sup> Equation (1) has been estimated excluding trade in oils and minerals from the dependent variable to control for the surge in commodities exports that took place in some African countries during the 2007. In addition, to account for the presence of zero trade values across country pairs, Tobit and Poisson specifications were used. Results, available under request, confirm the fact that inland transit has a negative and significant impact on export values.

<sup>9</sup> There are two differences with this study. First, authors use a difference gravity equation on similar exporters. In our case this strategy is not necessary since in our regressions we are considering only sub-Saharan Africa countries. Second, while they use the actual times in the transit country as instrument we use the time for the transit country's trade in the transit country

<sup>10</sup> Since our regression is perfectly identified we cannot test if the excluded instruments are not correlated with the error terms. In Table A2 of the Appendix we replicate the regressions of Table 4 but this time including separate instruments for customs and ports. In this case the Sargan overidentification test supports the validity of the instruments.

<sup>11</sup> This result does not only reflect the fact these countries are more isolated. Even though delays in inland transport are higher with respect to coastal countries (15 days versus 4 days on average), delays in documentation (24 days on average) and customs and ports (9 days on average) procedures are even higher for exporters in landlocked countries.

to about 9 percent more exports and a one percent reduction in transit delays leads to about 1.5 percent more trade.<sup>12</sup>

In Table 5 the effects of documentation, inland transit and customs and ports times on the exports of time-sensitive products are presented. Time delays should have a greater effect on exports of time-sensitive goods.<sup>13</sup> To examine the extent to which they are hampered, we follow the methodology in Djankov, Freund and Pham (2010) and estimate a difference-in-difference gravity equation using trade data of agricultural (processed and unprocessed) products for which time matters the most and the least. This methodology reduces the endogeneity problem coming from reverse causality because we control for country and industry fixed effects. In addition, the products we consider account for only a small fraction of trade in agricultural goods on average (less than 10 percent) so it is unlikely that they have a large impact on establishing trade facilitation processes.

We base our definition of time-sensitive agricultural products on the information of their storage life (Gast 1991), which includes a range of products going from a minimum storage life of 2 weeks or less, such as apricots, beans, currants, and mushrooms to 4 weeks or longer, for example apples, cranberries and potatoes and canned products. We also include goods with a very long storage life such as dry fruits with a maximum storage life of between 6 months and one year and canned products with a storage life ranging from 1 to 5 years, depending on the good's acidity. To measure time sensitivity we use the inverse of the median storage life of each product.

To study the joint effect of industry time-sensitivity and country time delays on exports we estimate the following difference-in-difference gravity regression

$$\begin{aligned} \ln Exports_{ik} = & \alpha_i + \alpha_k + \beta_1 (Time\ Sensit_k) \times (Inland\ transit\ time_i) + \beta_2 (Time\ Sensit_k) \times (Customs\ \&\ Ports\ time_i) \\ & + \beta_3 (Time\ Sensit_k) \times (Docs\ time_i) + \beta_4 (K\ abundance_i) \times (canned\ product_k) + \varepsilon_{ik} \end{aligned} \quad (2)$$

where  $\alpha_i$  and  $\alpha_k$  represent country- and industry-fixed effects. The coefficients  $\beta_1$ ,  $\beta_2$  and  $\beta_3$  capture the joint effect of time sensitive products and respectively time delays in inland transit, customs and ports and documentation on export values. We introduce the

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<sup>12</sup> When we include the log of total time as the only trade cost variable in the regression, we get a coefficient of about -1, the same as the results for developing countries in Djankov, Freund and Pham (2010), although they use a slightly different approach.

<sup>13</sup> Evans and Harrigan (2005) show that time-sensitive apparel products are more sensitive to distance than time-insensitive products.

term  $(Kabundance_i) \times (canned\ product_k)$  to control for the fact that more capital abundant countries are more likely to have the necessary resources and technologies to process fresh food into canned products.

With this specification we test whether exports of time-sensitive goods are more responsive to time delays in each of the key components of time to export than exports of time-insensitive products.

Table 5 presents the results for time-sensitive agricultural products controlling for countries' capital abundance. We report results for countries exporting at least one product and countries exporting at least 70 percent of the products, and also with the variables in logs and levels. In most of the cases, the coefficient on the interaction term of inland transit times with time sensitivity is negative and significant. This implies that an increase in inland transit times reduces exports of time-sensitive goods relatively more than time insensitive goods. In contrast, interactions with documents and customs and ports times are never significant.

More transit delays affect the composition of trade, preventing countries from exporting time-sensitive agricultural goods. Time-sensitive goods also tend to have higher value, implying that some of the effects of inland transit delays on aggregate exports results from countries with poor and not well targeted trade facilitation programs concentrating on low-value time insensitive goods.

In sum, we try three different ways to examine the effects of various trade delays on trade flows, each of which should reduce the endogeneity problem inherent in the analysis. All three point to the same conclusion: delays during inland transit affect trade flows to a much greater extent than delays because of documentation or at the port. Our results imply that reducing time spent on inland transit will significantly stimulate trade in Africa.

## **V. Why does inland transit matter more?**

All else equal, a one day delay should affect exports the same way no matter when it occurs. However, one reason it may not is if there is more uncertainty associated with high delays in some procedures than in others. Uncertainty will reduce exports because it makes delivery deadlines harder to meet. In this section, we investigate if greater

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uncertainty related to inland transport times makes costs related with documents, customs and ports become a secondary priority relative to travel costs for existing exporters.

We estimate the effects of time uncertainty in each component of export times for a sub-sample of 24 Sub-Saharan countries for which there is information on the maximum and the average number of days it takes for an exporter to complete each of the exporting procedures<sup>14</sup>:

$$\begin{aligned} \text{LnExports}_{ij} = & \beta_1 \text{Inland transit time uncert}_i + \beta_2 \text{Customs \& Ports time uncert}_i + \beta_3 \text{Docs time uncert}_i + \\ & + \beta_4 \text{Ln GDP}_i + \beta_5 \text{Ln Pop}_i + \beta_6 \text{Ln Dist}_{ij} + \beta_7 \text{Ln Remote}_i + \beta_8 \text{Landlock}_i + X_{ij} + \mu_j + \varepsilon_{ij} \end{aligned} \quad (3)$$

We define time uncertainty as the difference between the maximum time and the average time it takes to conclude each of the different phases representing the total time to export.

Results form Table 6 show a negative and significant impact of inland transit time uncertainty on trade values, with a one day increase in this variable leading to a reduction of exports of 13 percent (column (1)). Or in logs (Column (2)), a one percent increase in uncertainty leading to about a .7 percent reduction in exports. In contrast, uncertainty in the other variables is not significant in reducing exports. These results imply that high uncertainty in road transport times jeopardizes delivery targets. In addition, even if documentation requirements take more time than inland transit, they can either be done in advance or there may be learning by doing, such that exporters become more familiar with the procedures and uncertainty is limited. Finally, while exporters may be able to pay in the port to get things out more quickly, nothing can be done on the road.

In columns (3) and (4) we include both inland travel times and inland travel uncertainty. The coefficients reflecting both variables are significant. When we include only inland transit (see columns (5) and (6)) in the same sample the coefficient is larger, implying that part of the effect of transit time on exports stems from uncertainty.

Given the dominance of transit time over the other time cost variables, in determining trade, we next investigate whether this is a pure geography effect. Specifically, we control for domestic geography by using the GPS estimated distance and time based solely on geography and type of road. In our regressions we include road distance in km

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<sup>14</sup> Benin, Botswana, Burkina Faso, Burundi, Cameroon, Congo, Rep., Côte d'Ivoire, Ghana, Kenya, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Nigeria, Rwanda, Sierra Leone, South Africa, Sudan, Tanzania, Uganda, Zambia and Zimbabwe.

from the principal city to the port of export (which is the relevant distance for which transport is calculated in the data). In addition, we include GPS-estimated total travel time. This variable is calculated as the total time it takes to get from the principal city to the port of exit by assuming a speed of 40 km per hour for unpaved roads and 80 km per hour for paved surfaces.<sup>15</sup> Both variables enter the equation in logs. If transit is primarily a geography effect then the GPS variables should pick up the effect.

Table 7 reports the results using the full sample. GPS distance is negative and significant, but does not alter the effect of inland transit time (columns (1) and (2)). GPS travel time is negative, but is not significant and the coefficient is very small. Column (4) shows results with all three variables, only transit time and GPS distance are significant. Columns (5) and (6) show results excluding the transit time variable and the coefficients of the other two variables remain roughly the same. Column (7) shows the results in logs, and only transit time is significant.

The results suggest that the distance from city to port and whether roads are paved are not the main reason for long delays in transit times. There might be other factors such as the quality of the roads and vehicles, accidents, competition in trucking, road blocks or border waiting times which affect the total time for an exporter to get his goods from the factory to the port of exit.

## **VI. Conclusion**

We use detailed data on key components on the time it takes to move containerized products from the factory gate to the ship to estimate whether and how diverse trade costs affect export volumes in Sub-Saharan Africa. An augmented gravity equation is estimated by regressing aggregate bilateral exports on different time delay components such as inland transit, documentation, ports and customs, and other standard gravity variables.

To control for the possibility that more trade leads to improved trade facilitation, we investigate the effects that documentation, inland transport, customs and ports times respectively have on the exports of new products. Exports in these products are unlikely to have an impact on the historical development of infrastructure. As a robustness check we also use an instrumental variables approach to examine the effect of time trade costs in transit countries on the exports of landlocked countries. Finally, we estimate a

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<sup>15</sup> No information on road condition was used in the calculation of travel time. Furthermore, delays at the border (or otherwise) were not included.

“difference-in-difference” regression on a sub-sample of agricultural products to determine whether trade costs affect exports of time-sensitive and time-insensitive goods, ranging from perishable products where time is most critical relative to preserved goods such as tinned food, differently.

Our results imply that while inland transit delays have a robust negative impact on export values, higher times in other areas have much smaller effects in reducing Africa’s exports. A one day increase in inland transit time reduces exports by 7 percent on average. Put another way, a one day reduction in inland travel times translates into nearly a 1.5 percentage point decrease in all importing-country tariffs. In addition, this effect is higher for time-sensitive goods compared to time-insensitive goods. We show that long times are associated with high uncertainty in road transport, which jeopardizes exporters’ delivery targets.

Our results have important policy implications. Export tariffs in Sub-Saharan African countries are already at a very low level. Furthermore these countries have preferential access to markets such as the United States and the European Union. Hence, while the benefits from a further decrease in tariffs among trading partners might be very small – or even negative in terms of preference erosion if tariff reductions are MFN – reducing transport times will significantly increase their exports. Trade facilitation programs should therefore prioritize those programs directly affecting truck fleets and the infrastructure and security of Sub-Saharan Africa’s road systems.



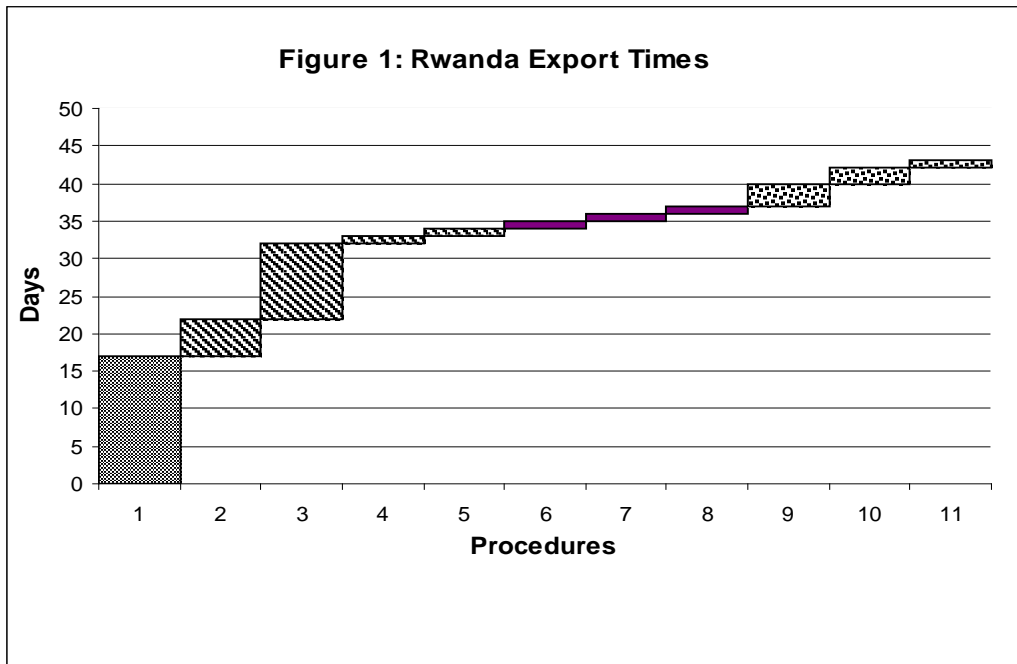
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**Figure 1: Export Procedures by Category**



List of procedures:

**-Documentation:**

1. Obtain bank related documents and reassemble all other export documents

**- Inland transit**

2. Pack and arrange transportation
3. Inland transportation
4. Additional clearance
5. Waiting time at border

**-Customs**

6. Customs clearance
7. Health/technical control
8. Pre-shipment

**-Ports**

9. Port and terminal handling
10. Waiting time
11. Loading onto vessel

**Table 1. Times to Export Descriptive Statistics by Geographic Region**

| Region                                    | Statistics | Documents | Customs and Ports | Inland Transit |
|---|------------|-----------|-------------------|----------------|
| <i>East Asia &amp; Pacific (19)</i>       | mean       | 13.3      | 7.2               | 4.1            |
|   | sd         | 10.1      | 4.1               | 3.3            |
| <i>Europe &amp; Central Asia (23)</i>     | mean       | 13.1      | 7.8               | 6.5            |
|   | sd         | 9.0       | 6.6               | 8.3            |
| <i>Latin America &amp; Caribbean (28)</i> | mean       | 11.6      | 7.8               | 4.0            |
|   | sd         | 6.7       | 6.6               | 3.1            |
| <i>Middle East &amp; Nord Africa (16)</i> | mean       | 13.4      | 6.7               | 4.8            |
|   | sd         | 12.9      | 4.3               | 4.9            |
| <i>OECD (24)</i>                          | mean       | 5         | 3.1               | 2.0            |
|   | sd         | 3.2       | 1.03              | 0.95           |
| <i>South Asia (8)</i>                     | mean       | 16.3      | 8.6               | 7.6            |
|   | sd         | 11.5      | 2.6               | 6.9            |
| <i>Sub-Saharan Africa (44)</i>            | mean       | 18.8      | 9.3               | 7.2            |
|   | sd         | 8.7       | 4.3               | 7.1            |

**Notes:** 1. The unit of measure is number of days. 2. Number of countries for each region in parenthesis.

**Table 2: Correlation of Explanatory Variables**

|                              | GDP   | POP   | Total Exp time | Docs  | Customs | Ports | Inland transp. | Docs (TC) | Customs (TC) | Ports (TC) | Inland transp. (TC) | Remote | GPS Dist. city to port | Travel time city to port | Uncert. Docs | Uncert. Customs and Ports | Uncert. Inland Transit |
|------------------------------|-------|-------|----------------|-------|---------|-------|----------------|-----------|--------------|------------|---------------------|--------|------------------------|--------------------------|--------------|---------------------------|------------------------|
| GDP                          | 1     |       |                |       |         |       |                |           |              |            |                     |        |                        |                          |              |                           |                        |
| POP                          | 0.59  | 1     |                |       |         |       |                |           |              |            |                     |        |                        |                          |              |                           |                        |
| Total Export time            | -0.08 | -0.04 | 1              |       |         |       |                |           |              |            |                     |        |                        |                          |              |                           |                        |
| Documents                    | -0.11 | -0.06 | 0.85           | 1     |         |       |                |           |              |            |                     |        |                        |                          |              |                           |                        |
| Customs                      | -0.01 | 0.11  | 0.36           | 0.17  | 1       |       |                |           |              |            |                     |        |                        |                          |              |                           |                        |
| Ports                        | 0.26  | 0.09  | 0.37           | 0.17  | 0.39    | 1     |                |           |              |            |                     |        |                        |                          |              |                           |                        |
| Inland transport             | -0.15 | -0.07 | 0.68           | 0.31  | 0.07    | -0.02 | 1              |           |              |            |                     |        |                        |                          |              |                           |                        |
| Docs (TC)                    | -0.05 | -0.04 | 0.52           | 0.71  | 0.29    | 0.30  | -0.08          | 1         |              |            |                     |        |                        |                          |              |                           |                        |
| Customs (TC)                 | 0.01  | -0.10 | 0.33           | 0.23  | 0.79    | 0.36  | -0.01          | 0.44      | 1            |            |                     |        |                        |                          |              |                           |                        |
| Ports (TC)                   | 0.22  | -0.01 | 0.36           | 0.20  | 0.28    | 0.90  | -0.02          | 0.30      | 0.36         | 1          |                     |        |                        |                          |              |                           |                        |
| Inland transp. (TC)          | 0.003 | 0.06  | 0.38           | 0.22  | 0.21    | 0.25  | 0.33           | 0.30      | 0.19         | 0.15       | 1                   |        |                        |                          |              |                           |                        |
| Remote                       | 0.01  | -0.14 | -0.26          | -0.16 | -0.21   | -0.16 | -0.21          | -0.17     | -0.10        | -0.16      | -0.01               | 1      |                        |                          |              |                           |                        |
| GPS Dist. city to port       | 0.01  | 0.02  | 0.58           | 0.45  | 0.30    | -0.03 | 0.54           | 0.18      | 0.19         | 0.06       | -0.004              | -0.46  | 1                      |                          |              |                           |                        |
| GPS travel time city to port | -0.01 | 0.01  | 0.63           | 0.46  | 0.20    | -0.03 | 0.67           | 0.09      | 0.08         | 0.04       | 0.01                | -0.42  | 0.95                   | 1                        |              |                           |                        |
| Uncert. Docs                 | -0.09 | -0.19 | -0.05          | 0.14  | 0.00    | -0.20 | -0.25          | 0.35      | -0.03        | -0.16      | 0.13                | 0.66   | -0.07                  | -0.20                    | 1            |                           |                        |
| Uncert. Customs and Ports    | 0.41  | 0.26  | -0.04          | 0.09  | -0.50   | -0.12 | -0.03          | -0.14     | -0.51        | 0.27       | -0.12               | 0.26   | 0.13                   | 0.19                     | 0.27         | 1                         |                        |
| Uncert. Inland Transit       | 0.08  | -0.18 | 0.59           | 0.59  | -0.07   | 0.07  | 0.25           | 0.20      | -0.14        | 0.10       | -0.16               | 0.09   | 0.37                   | 0.45                     | 0.13         | 0.22                      | 1                      |

Notes: TC stands for transit country.

**Table 3: The Effect of Export Time Components on Aggregate Exports (OLS Regression)**

| Dependent variable:<br>Aggregate exports | All<br>Products<br>(levels) | New<br>Products<br>(levels) | New<br>Products<br>(levels) | New<br>Products<br>(levels) | New<br>Products<br>(levels) | New<br>Products<br>(levels) | New<br>Products<br>(logs) |
|--|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|---------------------------|
|  | (1)                         | (2)                         | (3)                         | (4)                         | (5)                         | (6)                         | (7)                       |
| Inland transit time                      | -0.066***<br>[0.012]        | -0.067***<br>[0.015]        | -0.049***<br>[0.017]        |                             |                             | -0.070***<br>[0.024]        | -0.435***<br>[0.134]      |
| Customs and ports time                   | -0.046***<br>[0.014]        | -0.013<br>[0.014]           |                             | 0.016<br>[0.016]            |                             |                             |                           |
| Documents time                           | -0.054***<br>[0.007]        | -0.020***<br>[0.007]        |                             |                             | 0.018<br>[0.013]            |                             |                           |
| GDP                                      | 1.103***<br>[0.053]         | 0.960***<br>[0.061]         | 0.966***<br>[0.060]         | 0.970***<br>[0.061]         | 0.997***<br>[0.059]         | 1.024***<br>[0.084]         | 0.958***<br>[0.060]       |
| Population                               | -0.001<br>[0.048]           | -0.255***<br>[0.054]        | -0.259***<br>[0.054]        | -0.264***<br>[0.054]        | -0.277***<br>[0.053]        | -0.386***<br>[0.075]        | -0.219***<br>[0.057]      |
| Distance                                 | -1.186***<br>[0.125]        | -0.872***<br>[0.161]        | -0.874***<br>[0.160]        | -0.843***<br>[0.160]        | -0.857***<br>[0.160]        | -1.021***<br>[0.195]        | -0.844***<br>[0.160]      |
| Total time                               |                             |                             | -0.018***<br>[0.006]        | -0.031***<br>[0.006]        | -0.039***<br>[0.010]        | -0.016*<br>[0.008]          | -0.520**<br>[0.219]       |
| Tariffs (simple av.)                     |                             |                             |                             |                             |                             | -0.046**<br>[0.023]         |                           |
| Observations                             | 3793                        | 2054                        | 2054                        | 2054                        | 2054                        | 1142                        | 2054                      |
| R-squared                                | 0.512                       | 0.423                       | 0.423                       | 0.421                       | 0.421                       | 0.433                       | 0.422                     |

**Notes:** 1. Robust standard errors in brackets.\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. 2. Importer fixed effects, reporter remoteness, a dummy for landlocked countries and country pair specific variables (common language, common colony and common border) are included in all regressions.

**Table 4: The Effect of Export Time Components on Aggregate Exports  
Restricted Sample Regression**

| Dependent variable:<br>Aggregate exports | OLS<br>(levels)      | IV<br>(levels)       | IV<br>(levels)       | IV<br>(logs)         | IV<br>(logs)         |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|
|  | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  |
| Inland transit time                      | -0.126***<br>[0.015] | -0.097***<br>[0.020] | -0.088***<br>[0.031] | -1.517***<br>[0.475] | -1.520**<br>[0.686]  |
| Customs and ports time                   | -0.252***<br>[0.051] | 0.286<br>[0.254]     | 0.107<br>[0.305]     | 1.470<br>[1.641]     | 0.097<br>[2.216]     |
| Documents time                           | -0.048***<br>[0.011] | 0.047<br>[0.057]     | 0.028<br>[0.061]     | 0.447<br>[0.996]     | 0.093<br>[1.223]     |
| GDP                                      | 0.419***<br>[0.146]  | 0.125<br>[0.237]     | 0.686**<br>[0.334]   | 0.261<br>[0.166]     | 0.709***<br>[0.249]  |
| POP                                      | 0.562***<br>[0.148]  | -0.409<br>[0.479]    | -0.482<br>[0.564]    | -0.089<br>[0.451]    | -0.180<br>[0.606]    |
| Distance                                 | -1.110***<br>[0.290] | -0.905***<br>[0.295] | -1.371***<br>[0.357] | -0.936***<br>[0.294] | -1.377***<br>[0.349] |
| Tariffs (simple av.)                     |                      |                      | -0.059*<br>[0.030]   |                      | -0.058**<br>[0.029]  |
| Observations                             | 1038                 | 1038                 | 512                  | 1038                 | 512                  |
| R-squared                                | 0.553                | 0.489                | 0.526                | 0.522                | 0.544                |

**Notes:** 1. Robust standard errors in brackets.\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. 2. Importer fixed effects, reporter remoteness and country pair specific variables (common language and common colony) are included in all regressions.

**Table 5: The Effects of Export Time Components on Time Sensitive Products (OLS regression)**

| Dependent Variable                      | Countries exporting at least one product |                    | Countries exporting 70% of the products |                     |
|---|--|--------------------|---|---------------------|
|   | (levels)                                 | (logs)             | (levels)                                | (logs)              |
| Aggregate Exports by industry           | (1)                                      | (2)                | (3)                                     | (4)                 |
| Inland transit time*Time sensitivity    | -0.023<br>[0.014]                        | -0.174*<br>[0.096] | -0.038**<br>[0.017]                     | -0.229**<br>[0.109] |
| Customs and ports time*Time sensitivity | -0.002<br>[0.022]                        | 0.002<br>[0.200]   | -0.002<br>[0.025]                       | 0.037<br>[0.228]    |
| Documents time*Time sensitivity         | 0.014<br>[0.009]                         | 0.252<br>[0.182]   | 0.016<br>[0.010]                        | 0.226<br>[0.202]    |
| K abundance*Canned product              | 0.508**<br>[0.215]                       | 0.539**<br>[0.216] | 0.683***<br>[0.258]                     | 0.710***<br>[0.259] |
| Observations                            | 637                                      | 637                | 526                                     | 526                 |
| R-squared                               | 0.523                                    | 0.523              | 0.546                                   | 0.545               |

Notes: Standard errors in brackets \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 6: The Effect of Time Uncertainty on Aggregate Exports  
Overall Sample OLS Regression**

| Dependent Variable:                | Levels               | Logs                 | Levels               | Logs                 | Levels               | Logs                 |
|------------------------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Aggregate Exports                  | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
| Inland transit time uncertainty    | -0.126***<br>[0.021] | -0.662***<br>[0.093] | -0.100***<br>[0.022] | -0.270**<br>[0.111]  |                      |                      |
| Ports and customs time uncertainty | 0.023<br>[0.019]     | 0.228<br>[0.147]     |                      |                      |                      |                      |
| Documentation time uncertainty     | -0.005<br>[0.007]    | -0.174<br>[0.109]    |                      |                      |                      |                      |
| GDP                                | 1.534***<br>[0.094]  | 1.571***<br>[0.083]  | 1.401***<br>[0.087]  | 1.322***<br>[0.098]  | 1.211***<br>[0.076]  | 1.185***<br>[0.075]  |
| POP                                | -0.474***<br>[0.110] | -0.489***<br>[0.110] | -0.353***<br>[0.104] | -0.315***<br>[0.103] | -0.156*<br>[0.094]   | -0.219**<br>[0.093]  |
| Distance                           | -1.325***<br>[0.207] | -1.281***<br>[0.199] | -1.447***<br>[0.183] | -1.491***<br>[0.182] | -1.482***<br>[0.183] | -1.528***<br>[0.183] |
| Inland Transit Time                |                      |                      | -0.083***<br>[0.016] | -0.745***<br>[0.134] | -0.117***<br>[0.015] | -0.966***<br>[0.101] |
| Observations                       | 1679                 | 1663                 | 1881                 | 1881                 | 1881                 | 1881                 |
| R-squared                          | 0.600                | 0.592                | 0.595                | 0.597                | 0.589                | 0.595                |

Notes: 1. Robust standard errors in brackets.\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. 2. Importer fixed effects, reporter remoteness, a dummy for landlocked countries and country pair specific variables (common language, common colony and common border) are included in all regressions.



**Table 7: Inland Transit Times and Geography (OLS Regression)**

| VARIABLES                               | Levels<br>(1)        | Levels<br>(2)        | Levels<br>(3)        | Levels<br>(4)        | Levels<br>(5)        | Levels<br>(6)        | Logs<br>(7)          |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Inland transit time (levels)            | -0.085***<br>[0.012] | -0.083***<br>[0.012] | -0.081***<br>[0.013] | -0.088***<br>[0.013] |                      |                      | -0.914***<br>[0.110] |
| GDP                                     | 1.119***<br>[0.054]  | 1.144***<br>[0.056]  | 1.173***<br>[0.056]  | 1.182***<br>[0.057]  | 1.203***<br>[0.055]  | 1.240***<br>[0.055]  | 1.103***<br>[0.056]  |
| POP                                     | -0.074<br>[0.049]    | -0.077<br>[0.049]    | -0.185***<br>[0.049] | -0.191***<br>[0.049] | -0.142***<br>[0.048] | -0.246***<br>[0.048] | 0.023<br>[0.052]     |
| Distance                                | -1.091***<br>[0.130] | -1.085***<br>[0.130] | -1.147***<br>[0.132] | -1.145***<br>[0.133] | -0.994***<br>[0.131] | -1.059***<br>[0.133] | -1.075***<br>[0.128] |
| GPS distance principal city to port     |                      | -0.065***<br>[0.021] |                      | -0.093*<br>[0.056]   | -0.075***<br>[0.021] |                      | -0.034<br>[0.021]    |
| GPS travel times principal city to port |                      |                      | -0.0004<br>[0.065]   | 0.248<br>[0.168]     |                      | -0.090<br>[0.063]    |                      |
| Observations                            | 3793                 | 3793                 | 3644                 | 3644                 | 3793                 | 3644                 | 3793                 |
| R-squared                               | 0.498                | 0.499                | 0.501                | 0.502                | 0.493                | 0.495                | 0.504                |

**Notes:** 1. Robust standard errors in brackets.\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. 2. Importer fixed effects, reporter remoteness, a dummy for landlocked countries and country pair specific variables (common language, common colony and common border) are included in all regressions.

## APPENDIX

**Table A1: Summary Results for First Stage Regressions**

|                                 | Partial R2 | F statistic | p-value |
|---------------------------------|------------|-------------|---------|
| Inland transit time (levels)    | 0.4063     | 96.26       | 0.000   |
| Customs and ports time (levels) | 0.2251     | 40.85       | 0.000   |
| Documents time (levels)         | 0.3087     | 62.83       | 0.000   |
| Inland transit time (logs)      | 0.2935     | 122.43      | 0.000   |
| Customs and ports time (logs)   | 0.3816     | 181.8       | 0.000   |
| Documents time (logs)           | 0.2765     | 112.61      | 0.000   |

**Table A2: IV Restricted Sample Regressions using  
Customs and Ports as Separate Instruments**

| Dependent variable:<br>Aggregate exports | Levels               | Levels               | Logs                 | Logs                 |
|--|----------------------|----------------------|----------------------|----------------------|
|  | (1)                  | (2)                  | (3)                  | (4)                  |
| Inland transit time                      | -0.090***<br>[0.018] | -0.093***<br>[0.028] | -1.415***<br>[0.443] | -1.651**<br>[0.641]  |
| Customs and ports time                   | 0.087<br>[0.102]     | 0.186<br>[0.140]     | 0.698<br>[1.377]     | 0.716<br>[1.819]     |
| Documents time                           | 0.004<br>[0.026]     | 0.043<br>[0.033]     | 0.046<br>[0.858]     | 0.338<br>[1.070]     |
| GDP                                      | 0.287**<br>[0.139]   | 0.609***<br>[0.206]  | 0.305**<br>[0.154]   | 0.652***<br>[0.229]  |
| POP                                      | -0.049<br>[0.224]    | -0.618*<br>[0.323]   | 0.067<br>[0.401]     | -0.279<br>[0.553]    |
| Distance                                 | -0.899***<br>[0.283] | -1.368***<br>[0.361] | -0.887***<br>[0.284] | -1.393***<br>[0.350] |
| Tariffs (simple av.)                     |                      | -0.063**<br>[0.029]  |                      | -0.063**<br>[0.028]  |
| Observations                             | 1038                 | 512                  | 1038                 | 512                  |
| R-squared                                | 0.529                | 0.513                | 0.535                | 0.538                |
| Sargan statistic                         | 0.807                | 0.0834               | 0.927                | 0.308                |
| p-value of Sargan statistic              | 0.369                | 0.773                | 0.336                | 0.579                |

**Notes:** 1. Robust standard errors in brackets.\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. 2. Importer fixed effects, reporter remoteness and country pair specific variables (common language and common colony) are included in all regressions.