The Determinants of Industrialization in Sub-Saharan Africa

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THE DETERMINANTS OF INDUSTRIALIZATION IN SUB-SAHARAN AFRICA

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DÉCLARATION

DÉDICACE

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0.1 Abstract

This thesis examines the determinants of industrialization in sub-Saharan African countries. Except for chapter 1, which is the general introduction, the dissertation is organized into two parts: internal and external determinants. The first part includes two chapters (chapter 1 and chapter 2) and the second part covers three chapters (chapter 3, chapter 4 and chapter 5).

Chapter 2 analyzes the empirical effects of production losses arising from power outages on employment in manufacturing firms operating in sub-Saharan Africa. The evidence indicates that workers in the production unit are negatively affected by the output losses experienced by firms during a power outage. Furthermore, unskilled and temporary workers are more vulnerable to production losses due to power outages than skilled workers. In addition, the transaction costs associated with the use of generators, beyond a certain threshold, lead firms to lay off employees.

Chapter 3 examines the impacts of power outages and exchange rate undervaluation on the movement of manufacturing firms between the domestic and export markets. As electricity shortages become more severe, firms move more towards the domestic market at the expense of the export market, while undervaluation leads to the opposite movement. Also, the econometric estimates reveal that the above-mentioned effects are influenced by some characteristics related to manufacturing firms and countries.

Chapter 4 explores the relationship between remittances and firm capital accumulation, sales, and employment. Findings show that remittances contribute to employment and capital acquisition in manufacturing firms by nationals. However, remittances reduce manufacturing firms' sales through competitive pressures from foreign manufactured goods. Heterogeneity tests reveal that the above results are affected by some firm and country specificities.

Chapter 5 provides an empirical study and theoretical discussion of the effects of industrial and trade policies on structural transformation in sub-Saharan Africa. The theoretical discussion concludes that industrial and trade policies have failed

to industrialize sub-Saharan Africa, while they have been a key determinant in the industrialization process of East Asian countries. The empirical analysis reveals a negative impact of trade openness on structural transformation between the agricultural and manufacturing sectors. Moreover, this negative effect is exclusively driven by natural resource exports.

Chapter 6 focuses on the influence of South-South trade on industrialization in Africa. Comparisons through descriptive statistics and econometric models show a negative impact of Africa's total exports to China on industrialization. However, exports from other developing countries to China positively affect industrialization. In the case of Africa and other developing countries, imports from China are negatively associated to industrialization.

0.2 Résumé

La présente thèse étudie les déterminants de l'industrialisation des pays de l'Afrique subsaharienne. Excepté le chapitre 1 qui concerne l'introduction générale, la thèse s'organise en deux parties: déterminants internes et déterminants externes. La première partie comporte deux chapitres (chapitre 1 et chapitre 2) et la seconde partie en comprend trois (chapitre 3, chapitre 4 et chapitre 5).

Le chapitre 2 analyse les effets empiriques des pertes de production causées par les coupures électriques sur l'emploi des entreprises manufacturières en Afrique subsaharienne. Il apparaît que les travailleurs dans l'unité de production sont négativement affectés par les pertes de production que les firmes subissent lors d'une coupure électrique. Par ailleurs, les travailleurs non qualifiés et ceux temporaires sont plus vulnérables aux pertes de production dues aux coupures électriques par rapport aux travailleurs qualifiés. De plus, les coûts de transaction liés à l'utilisation des groupes électrogènes, à un certain seuil, conduisent les entreprises à licencier des employés.

Le chapitre 3 étudie les impacts des coupures électriques ainsi que ceux de la sous-évaluation du taux de change sur le mouvement des firmes manufacturières entre le marché domestique et le marché des exportations. Nous trouvons qu'à mesure que les coupures électriques durent, les firmes s'orientent davantage vers le marché domestique au détriment du marché des exportations alors que la sous-évaluation entraîne un mouvement contraire. Également, les estimations économétriques montrent que les effets ci-dessus mentionnés sont influencés par certaines caractéristiques liées aux entreprises manufacturières et aux pays.

Le chapitre 4 traite du lien entre les envois de fonds des migrants et l'accumulation du capital, les ventes et l'emploi des entreprises. Il ressort que les envois de fonds des migrants contribuent à l'emploi et à l'acquisition du capital des firmes manufacturières par les nationaux. Cependant, ces fonds réduisent les ventes des entreprises manufacturières à travers les pressions concurrentielles exercées par les produits manufacturés importés. Des tests d'hétérogénéité révèlent que les résultats ci-dessus sont impactés par quelques spécificités des firmes et des pays.

Le chapitre 5 réalise une étude empirique et une discussion théorique concernant les effets des politiques industrielles et commerciales sur la transformation structurelle en Afrique subsaharienne. Les discussions théoriques établissent que les politiques industrielles et commerciales ont échoué à industrialiser l'Afrique subsaharienne tandis qu'elles ont été un déterminant essentiel dans le processus d'industrialisation des pays d'Asie de l'Est. Les analyses empiriques quant à elles suggèrent un impact négatif de l'ouverture commerciale sur la transformation entre le secteur agricole et manufacturier. Par ailleurs, cet effet négatif passe exclusivement par les exportations des ressources naturelles.

Le chapitre 6 se concentre sur l'influence du commerce Sud-Sud sur l'industrialisation en Afrique. Les comparaisons effectuées au moyen de statistiques descriptives et de modèles économétriques montrent que les exportations totales de l'Afrique vers la Chine ont un impact négatif sur l'industrialisation. En revanche, les exportations des autres pays en développement vers la Chine ont un effet positif sur l'industrialisation. Dans le cas de l'Afrique et des autres pays en développement, les importations en provenance de la Chine sont négativement associées à l'industrialisation.

Chapter 1

General Introduction

Abstract

Le présent chapitre qui introduit la thèse concernant l'étude des déterminants de l'industrialisation, à travers une discussion théorique, a deux principaux objectifs. Premièrement, il éclaire sur l'importance et le rôle du secteur manufacturier dans le processus de développement des nations tout en mettant en lumière le retard d'industrialisation des pays de l'Afrique subsaharienne. Deuxièmement, les contraintes et obstacles empêchant le déclenchement d'une forte croissance manufacturière pouvant conduire à un rattrapage des économies Africaines sont discutés. Dans ce sens, ce chapitre met en lumière les déterminants les plus incontournables d'une industrialisation répondant aux défis démographiques et de lutte contre la pauvreté en Afrique. A travers cette introduction générale, les facteurs de l'industrialisation s'organisent en deux principales parties à savoir: déterminants internes et externes.

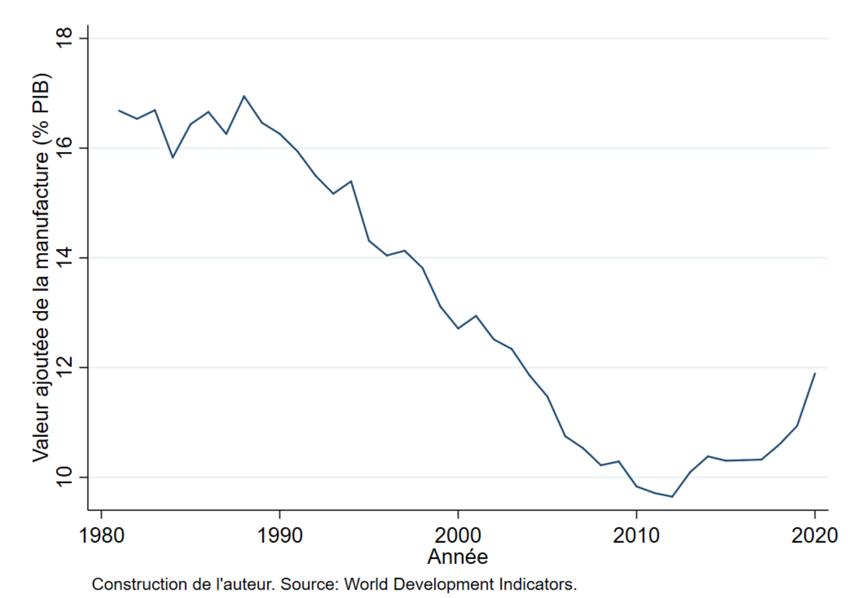
1.1 Introduction

Quelles sont les causes du développement économique des nations? Pourquoi certaines nations du monde connaissent une prospérité économique pendant que d'autres ont des revenus par tête faibles? Telles sont les questions que se posaient les économistes du développement au lendemain des indépendances des pays d'Asie, d'Amérique Latine et d'Afrique. Les réponses vont des différences géographiques (Sachs, 2001; Gallup et al., 1999; Diamond, 1997), au commerce international (Sachs et al., 1995), ainsi qu'aux différences dans la qualité des institutions (Acemoglu et al., 2014; Acemoglu et al., 2005; Acemoglu et al., 2001; North, 1996; Hall & Jones, 1993). Bien qu'il n'y ait pas de consensus sur la formule magique de la prospérité économique des nations, les pays à haut niveau de vie partagent une caractéristique commune : l'industrialisation. Définie comme la croissance du secteur manufacturier dans l'activité économique globale, l'industrialisation a été de tout temps le chemin naturel vers le développement économique. Qu'il s'agisse des pays occidentaux (révolution industrielle) ou des pays d'Asie de l'Est (miracle asiatique), l'industrialisation a été la clé du succès économique des nations les plus développées au monde (Murphy et al., 1989*b*; Lewis, 1954). Elle repose sur un changement dans l'allocation des ressources, notamment de la main-d'oeuvre, des secteurs traditionnels (l'agriculture et d'autres activités informelles) vers le secteur moderne (la manufacture). La croissance du secteur manufacturier par rapport aux autres secteurs est ainsi le déplacement de la force de travail des activités à faible productivité vers celle à productivité élevée. Ce processus entraîne un accroissement de la productivité totale des facteurs, une croissance du revenu des travailleurs ainsi que leur niveau de vie (McMillan & Headey, 2014; McMillan & Rodrik, 2011). Néanmoins, le changement structurel impliquant une dynamique de développement économique n'a pas eu lieu en Afrique subsaharienne (ASS). Dans certains cas, les ressources sont passées du secteur manufacturier au secteur informel - désindustrialisation - (McMillan & Rodrik, 2011). Depuis les années 1980, l'ASS connaît une désindustrialisation caractérisée par une baisse de la part de la valeur ajoutée (VA) du secteur manufacturier dans le PIB (Figure 1.1).

De 16,68% en 1981, la VA de la manufacture rapportée au PIB était de 11,89% en 2019. Bien que la période 2013-2019 semble être marquée par une légère reprise, la situation industrielle de l'ASS en 1981 reste nettement meilleure à celle de nos jours (Figure 1.1).

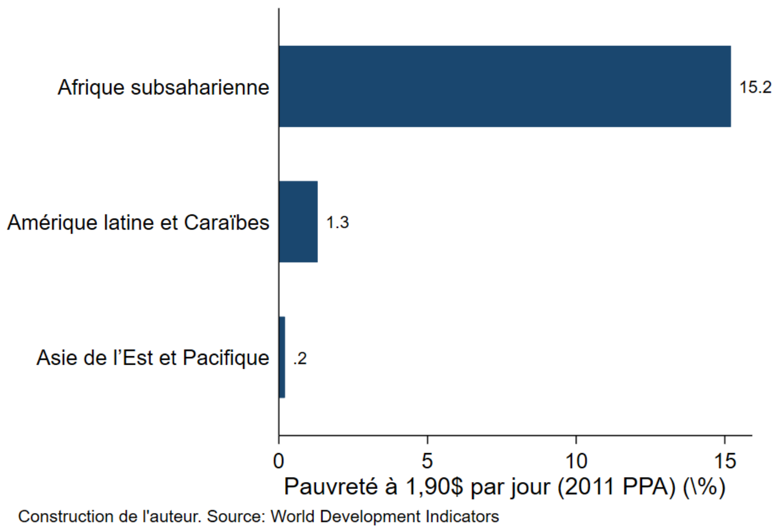
Si l'industrialisation est le leitmotiv du développement économique, alors elle doit être au coeur des politiques de lutte contre la pauvreté dans les pays les moins avancés; elle doit l'être encore plus dans le cas de l'ASS. En effet, cette région a l'incidence de la pauvreté la plus élevée parmi les régions en développement (Figure 1.2). Le taux de pauvreté y est respectivement 11,69 et 76 fois plus élevé comparé à l'Amérique Latine et Caraïbes ainsi qu'à l'Asie de l'Est et Pacifique. La question de l'expansion du secteur manufacturier est encore plus pertinente, incontournable et urgente en ce sens que l'ASS connaît une croissance démographique inédite dans son histoire. Si l'Afrique a fait l'expérience d'une forte progression économique mais éphémère dans les années 2000, sa croissance démographique reste forte et soutenue dans le temps.

Figure 1.1: Évolution de la valeur ajoutée du secteur manufacturier (% PIB) entre 1981 et 2019



La part de la valeur ajoutée du secteur manufacturier dans le PIB est une des mesures de l'industrialisation utilisées dans les travaux de recherche. Son évolution dans le temps traduit soit une dynamique d'industrialisation (hausse) soit une dynamique de désindustrialisation (baisse).

Figure 1.2: Incidence de la pauvreté entre les régions en développement en 2019



L'incidence de la pauvreté est mesurée par l'écart entre la consommation journalière des pauvres et le seuil de pauvreté de 1,90$ par jour. Elle est le manque moyen de revenu ou de consommation par rapport au seuil de pauvreté de 1,90$ par jour, exprimé en pourcentage du seuil de pauvreté.

La population africaine va presque doubler entre 2021 et 2050.[1] De 1,4 milliard d'habitants en 2021, elle comptera 2,5 milliards de personnes en 2050 (Données CNUCED). En plus de son augmentation, la répartition de la population entre les zones urbaines et rurales se modifiera considérablement. La part de la population urbaine dans la population totale passera de 44% en 2021 à 59% en 2050. La structure démographique se modifiera également en faveur d'une hausse de la proportion des jeunes adultes dans la population totale. La croissance démographique et la modification de sa structure entraîneront une entrée inédite de jeunes sur le marché du travail africain. Selon les données de la Banque Africaine de développement (BAD), l'Afrique aura la main-d'oeuvre la plus jeune du monde avec 500 millions de personnes sur son marché du travail. Jusqu'en 2050, le marché du travail africain accueillera 12 millions de jeunes par an. Ainsi, l'industrialisation, en créant plus d'emplois, empêchera la croissance démographique d'être une source d'émigration illégale, d'instabilité socio-politique et de conflits terroristes en ASS. En effet, les conflits violants et instabilités politiques sont de plus en plus expliqués par les determinants economiques. Par conséquent, le développement rapide du secteur manufacturier de l'ASS n'est pas uniquement un impératif économique, mais également, une nécessité sociale et sécuritaire pour cette région. Le secteur manufacturier ayant une productivité moyenne, sa croissance devrait permettre d'absorber une part importante de la main-d'oeuvre fournie par l'explosion démographique.[2] Au-delà de l'accroissement spectaculaire que connaîtra l'ASS en matière d'offre de force de travail, la demande en biens de consommation suivra aussi une trajectoire de croissance. La dépense de consommation passera de 1,4 milliard de dollars en 2020 à 2,1 milliards de dollars en 2025 (Données BAD). Par ailleurs, d'ici 2030, 2 milliards de personnes en Afrique auront besoin de nourriture et d'autres biens manufacturés comme les vêtements.

Toutefois, de nos jours, la situation industrielle de l'ASS ne semble pas être à la hauteur des défis de création d'emploi et de soutien à la demande domestique croissante. Pour la main-d'oeuvre, le secteur industriel de l'ASS ne représente que

[1]Pour plus de détails sur la récente croissance économique en ASS voir la section suivante.

[2]Le terme «productivité moyenne» désigne une productivité se situant entre les secteurs à faible productivité et les services hautement technologiques (voir Rodrik, 2016*a*).

10,69% de l'emploi total pendant que la part de l'emploi dans les services ainsi que celle dans l'agriculture représentent respectivement 36,45% et 52,87% de l'emploi total (Figure 1.3).[3] Ainsi, l'agriculture qui est le secteur à faible productivité emploie plus de la moitié de la population active suivie des services qui sont constitués à la fois des services informels et des services hautement technologiques.[4] En plus du faible taux d'emploi de l'industrie par rapport aux autres secteurs d'activité, ce secteur demeure le plus inégalitaire en termes d'emploi entre les femmes et les hommes (Figure 1.4). En effet, les femmes travaillant dans l'industrie représentent 7,63% de l'emploi total des femmes en ASS tandis que la part des hommes dans le secteur industriel est de 13,19% de l'emploi total des hommes. L'écart entre l'emploi des hommes et des femmes en termes de proportion par genre est de 5,56%. Par ailleurs, cet écart est de 6,12% dans le secteur des services mais en faveur de l'emploi des femmes. En outre, l'agriculture est le secteur le plus égalitaire avec un écart négligeable de 0,46%. Bien que la demande de l'ASS en produits manufacturés soit en forte progression, son secteur manufacturier ne représente de nos jours qu'une part faible du PIB comparée à celle des autres secteurs. En 2019, les parts des VA des services et de l'agriculture dans le PIB étaient respectivement de 49,48% et 15,53% pendant que celle du secteur manufacturier était de 11,89% (Figure 1.5).

De ce qui précède, la présente thèse cherche à comprendre pourquoi le secteur manufacturier, malgré son rôle crucial dans la réduction de la pauvreté, contribue marginalement à l'emploi et à la production totale. Pour ce faire, elle étudie, empiriquement, les déterminants de l'industrialisation des pays de l'ASS, tout en s'organisant en deux parties à savoir: déterminants internes et déterminants externes. Le but est de contribuer d'une part, à la réflexion scientifique sur la problématique de l'industrialisation en ASS, et d'autre part, aux recommandations de politiques industrielles et des politiques de lutte contre la pauvreté. Ce travail de recherche apporte à la littérature de quatre manières différentes. Premièrement,

[3] L'emploi dans le secteur industriel est considéré car celui dans le secteur manufacturier n'existe pas dans les bases de données en accès libre. Toutefois, selon l'analyse de certains auteurs comme Lin (2011*a*), l'emploi manufacturier en ASS devrait également tourner autour de 10%.

[4] Voir la base de données de la Banque Mondiale pour la constitution des secteurs d'activité.

il utilise des stratégies de spécification combinant simultanément des données au niveau pays et au niveau entreprise (chapitre 2, chapitre 3, chapitre 4). Ces spécifications permettent des recommandations plus efficaces et pertinentes des politiques industrielles. En effet, elles permettent de mettre en lumière les différences qui pourraient exister entre des catégories distinctes d'entreprises et de pays.[5] A travers ces spécifications économétriques, les hétérogénéités individuelles liées aux industries et aux pays dans lesquels exercent les firmes sont également prises en compte simultanément. Par contre, les études de l'industrialisation au niveau macro-économique, comme c'est le cas dans plusieurs travaux (Rodrik, 2016*b*; Gui-Diby & Renard, 2015; McMillan & Harttgen, 2014; Kang & Lee, 2011; McMillan & Rodrik, 2011) ne permettent de considérer que les disparités entre pays. Dans cette logique, les estimations économétriques issues d'une combinaison des variables au niveau pays et entreprise devraient être plus proches de la réalité donc plus pertinentes dans un contexte de politique industrielle. Deuxièmement, des modèles macro-économétriques dynamiques considérant simultanément les évolutions de long terme et de court terme de l'industrialisation et de ses déterminants sont appliqués (chapitre 5). De telles méthodes économétriques restent pertinentes en ce sens qu'elles permettent de recommander des politiques industrielles qui évoluent dans le temps en fonction de la situation économique changeante de l'ASS. Cependant, une politique industrielle reposant sur des modèles non-dynamiques ne prendra pas en compte les réalités de court terme et de long terme de l'industrialisation et de ses déterminants.[6] Troisièmement, nous contribuons à la littérature sur les mesures de la transformation structurelle en proposant un nouvel indicateur de changement structurel (chapitre 5).

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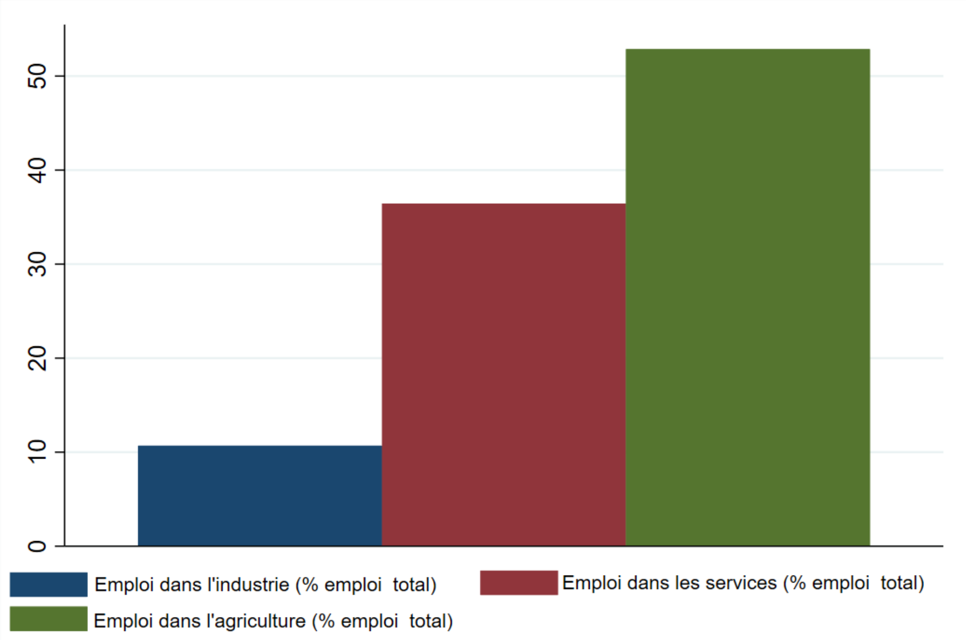
[5] Par exemple, il est peu probable que les firmes de tailles et de technologies différentes soient affectées de la même manière par une contrainte industrielle. De même, les pays riches en ressources naturelles, ceux ouverts aux flux commerciaux et financiers devraient être différemment affectés par ces contraintes par rapport à ceux non riches en ressources et peu ouverts au commerce international ainsi qu'aux flux financiers.

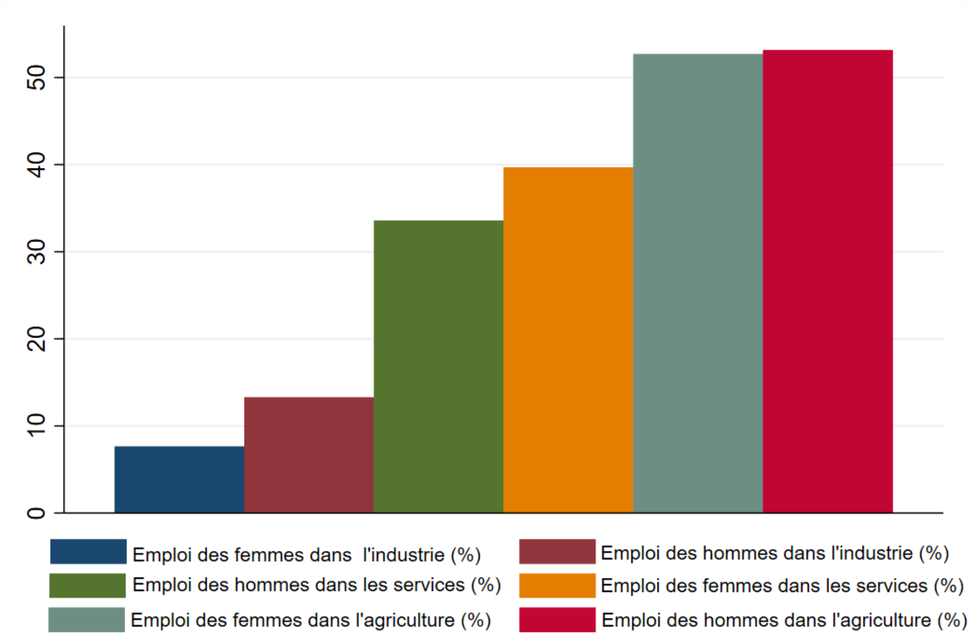
[6] Allusion est faite ici aux modèles non-dynamiques ne considérant pas simultanément la dynamique de long terme et de court terme des variables.

Figure 1.3: Répartition de l'emploi total par secteur en Afrique subsaharienne en 2019 (%)



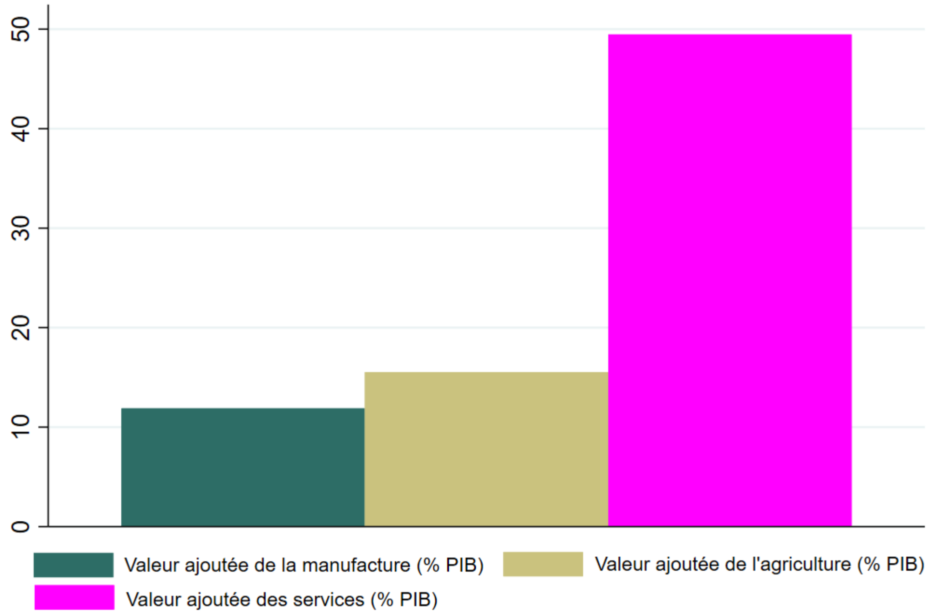
Construction de l'auteur. Source: World Development Indicators.

Figure 1.4: Répartition par genre de l'emploi total par secteur en Afrique subsaharienne en 2019 (%)



Construction de l'auteur. Source: World Development Indicators.

Figure 1.5: Part de la valeur ajoutée de chaque secteur dans le PIB en Afrique subsaharienne en 2020 (%)



Construction de l'auteur. Source: World Development Indicators.

Enfin, la présente thèse part d'une discussion théorique mettant en lumière la situation industrielle de l'ASS et d'Asie pendant les périodes coloniales et celles des indépendances jusqu'à nos jours (chapitre 5 et chapitre 6). Une telle discussion permet d'illustrer les erreurs de politiques industrielles antérieures en ASS notamment celles de la période des indépendances afin de les éviter à l'avenir.

La suite de cette introduction générale s'organise en trois parties. La section 1.2 est consacrée à une analyse de la récente croissance économique de l'Afrique afin de comprendre les facteurs qui sous-tendent l'industrialisation de l'ASS. La section 1.3 est consacrée à un approfondissement de ces facteurs en vue de définir les deux principales parties ainsi que les différents chapitres de cette thèse. La section 1.4, à partir de la littérature existante, expose les différentes mesures de l'industrialisation. Enfin, la section 1.5 sera conclusion.

1.2 La récente croissance économique de l'Afrique subsaharienne est-elle une histoire d'industrialisation?

Le début des années 2000 a été marqué par une reprise de la croissance économique dans de nombreux pays d'Afrique. Cette performance sans précédent depuis la période des indépendances a mis en évidence un contraste saisissant. Une dissemblance entre une nouvelle Afrique qui affiche l'un des taux de croissance économique les plus élevés au monde et une Afrique qui a enregistré une baisse permanente de son niveau de vie dans les années 1980. Ce constat a alimenté les débats sur un éventuel "miracle" africain à l'instar des pays d'Asie de l'Est (Rodrik, 2016*a*). Dans le cas de l'Afrique en général, le terme "miracle" fait référence au fait qu'elle a pu sortir d'un piège de croissance négative du PIB par habitant entre 1980 et 2000 pour atteindre une croissance positive. En ASS, la croissance moyenne du PIB par habitant était de -1% et de -0,70% pendant respectivement les périodes 1980-1990 et 1990-2000 (Figure 1.6). Entre 2000 et 2010, cette croissance a atteint 3% (Figure 1.6), mais elle a diminué après 2010, ce qui soulève des doutes quant à sa soutenabilité. Comme l'explique Rodrik (2016*a*), bien que cette poussée de croissance ne soit pas comparable à celle qu'ont connue les pays d'Asie de l'Est, elle reste une meilleure performance par rapport à l'Amérique latine.

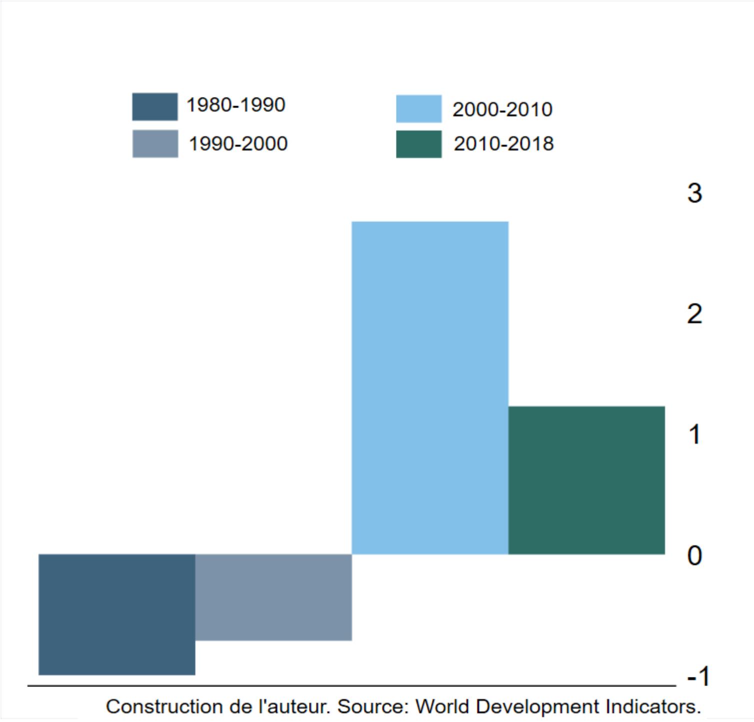


Figure 1.6: Croissance moyenne du PIB par habitant par sous-périodes

De ce qui précède, une question importante émerge. La forte croissance économique de l'ASS est-elle le résultat de l'expansion du secteur manufacturier ? Si oui, nous devrions nous attendre à une corrélation positive entre la croissance économique et le progrès de l'industrie manufacturière. Selon Murphy et al. (1989*b*), la plupart des histoires de forte croissance du PIB par habitant améliorant le niveau de vie sont le fait d'une expansion du secteur manufacturier, donc de l'industrialisation. Cependant, cela ne semble pas être le cas en ASS. Alors que la croissance du PIB par habitant a été positive entre 2000 et 2010, celle de la part de la VA du secteur manufacturier dans le PIB a été négative pendant la même période. Alors que le taux de croissance du PIB par tête était d'environ 3%, l'ASS enregistrait un taux de croissance de la VA manufacturière (%PIB) d'un peu plus de -2% (Figure 1.7). Bien que cette période ne soit pas celle du miracle asiatique, on peut constater que la croissance du PIB par habitant et celle de la part de la VA manufacturière dans le PIB ont suivi une trajectoire positive (Figure 1.7). De plus, les deux taux de croissance semblent approximativement identiques mettant en lumière la forte corrélation entre le PIB par habitant et la production manufacturière en Asie de l'Est. En outre, la croissance en ASS n'a pas été suivie d'un mouvement de la main-d'oeuvre vers le secteur industriel, bien que l'emploi dans l'agriculture ait diminué. Au cours de la période 2000-2010, le taux de croissance de la part de l'emploi industriel dans l'emploi total a connu une évolution négative, alors que le PIB par tête poursuivait sa poussée (Figure 1.9). Sur la même période, l'emploi dans le secteur agricole baissait de 62% à environ 50% de l'emploi total (Figure 2.11). Dans le cas de l'Asie de l'Est, le taux de croissance de la part de l'emploi industriel dans l'emploi total et celui du PIB par tête étaient positifs (Figure 1.9).[7]

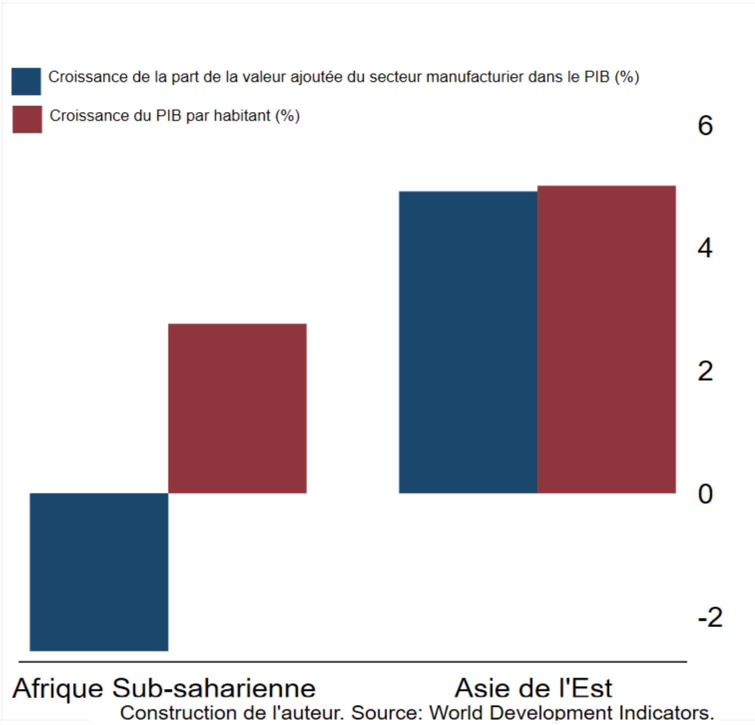


Figure 1.7: La croissance de la part de l'industrie manufacturière dans le PIB et la croissance du PIB par habitant

[7]L'emploi industriel est représenté sur la Figure 1.9 parce que les données macro-économiques de l'emploi dans le secteur manufacturier pour tous les pays de l'ASS ne sont pas disponibles dans les bases de données en accès libre.

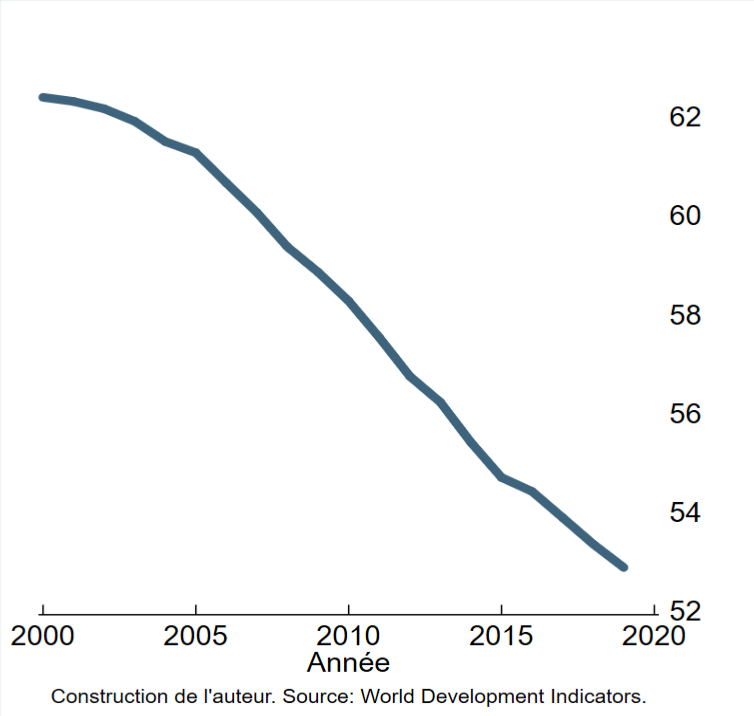


Figure 1.8: La part de l'agriculture dans l'emploi total

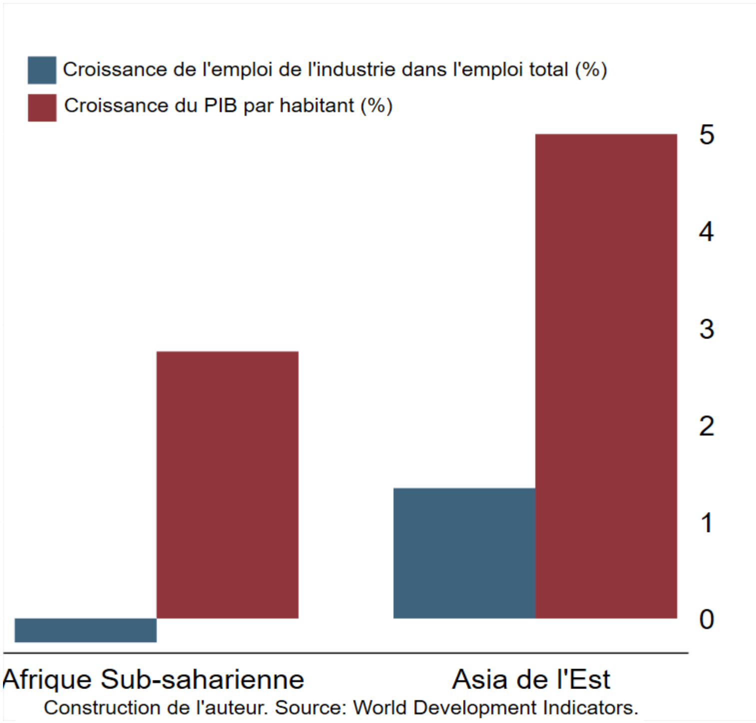


Figure 1.9: La croissance de la part de l'emploi industriel dans l'emploi total et la croissance du PIB par habitant

Les graphiques précédents montrent une réalité importante en ASS. En effet, les performances économiques récentes de cette région ne sont pas le fruit de la croissance du secteur manufacturier, et le déclin de l'emploi agricole ne semble pas être absorbé par le secteur industriel. Cela soulève deux grandes questions. Premièrement, si la croissance des années 2000 n'est pas une histoire de croissance manufacturière, comment expliquer cette performance économique? Deuxièmement, étant donné que la croissance de l'emploi industriel a été négative entre 2000 et 2010, on peut se demander pourquoi les entreprises de ce secteur ne sont pas en mesure d'absorber la main-d'oeuvre en provenance du secteur agricole? En ce qui concerne la première question, il convient de noter que les années 2000 ont été marquées par quelques conditions externes favorables aux économies de l'ASS. Selon Rodrik (2016*a*), ces pays ont bénéficié des prix élevés des matières premières, des taux d'intérêt bas et de l'augmentation des transferts de fonds des migrants. De plus, l'ASS aurait bénéficié de la croissance économique rapide de la Chine à travers une forte demande pour ses ressources naturelles. La réduction de la croissance pourrait donc s'expliquer par la disparition progressive de ces conditions externes favorables. La seconde question pourrait s'expliquer par les contraintes ou obstacles internes pesant sur l'activité des firmes manufacturières en ASS. En résumé, en fonction des conditions internes et externes, il existe quatre scénarios de croissance et d'industrialisation.

- **Scénario 1:** Si les conditions externes sont bonnes alors que les conditions internes sont mauvaises, il y aura une croissance épisodique (CE) qui sera réduite si les bonnes conditions externes disparaissent. En raison des mauvaises conditions internes, il pourrait y avoir, au mieux, une absence d'industrialisation, au pire, un déplacement des ressources des firmes manufacturières vers le secteur traditionnel - désindustrialisation -. En effet, si certaines contraintes notamment infrastructurelles et institutionnelles entravent l'activité industrielle, les entreprises souffriront de pertes de productivité et d'une hausse des coûts de transaction, ce qui les rendra moins disposées à accueillir la main-d'oeuvre non qualifiée des secteurs informels. Si les conditions externes favorisent d'autres secteurs comme celui des matières premières (matières premières agricoles et minérales), le mouvement des ressources vers ce secteur sera accéléré, ce qui peut potentiellement évincer le secteur manufacturier, et se traduire par un phénomène du syndrome hollandais.

- **Scénario 2:** Si les conditions externes et internes sont toutes les deux mauvaises, il n'y aura ni CE ni industrialisation. Les mauvaises conditions externes peuvent même aggraver les effets délétères des contraintes internes. Par exemple, la baisse des rentes des exportations de ressources naturelles prive les pays de fonds importants pour l'amélioration de la qualité des services publics. Les coûts de transaction et les pertes de productivité au sein des entreprises manufacturières augmenteront encore plus. Des coûts de transaction et des pertes de productivité très élevés pourraient conduire les entreprises à des vagues de licenciements des travailleurs qui pourraient se réfugier dans le secteur informel, ce qui enclenchera un processus de désindustrialisation.

- **Scénario 3:** Si les conditions externes et internes sont toutes les deux bonnes, la CE accélérera le rythme de l'industrialisation due aux bonnes conditions internes. Ce scénario permet une croissance économique, entraînant un véritable processus d'industrialisation et de rattrapage. En effet, les économies ayant des infrastructures permettant d'améliorer la productivité et donc la compétitivité des firmes, sont susceptibles d'attirer les entreprises d'autres régions du monde dans leur secteur manufacturier. Également, une forte hausse de la demande mondiale en produits manufacturés induira une augmentation significative des exportations de biens industriels par ces économies compétitives.

- **Scénario 4:** Si les conditions externes sont mauvaises et que les conditions internes sont bonnes, il n'y aura pas de CE alors qu'il y aura un processus d'industrialisation. Cependant, les mauvaises conditions externes pourraient réduire le rythme de la croissance du secteur manufacturier. Dans ce scénario, la direction de l'industrialisation ne changera pas, le mouvement de la main-d'oeuvre se fera du secteur traditionnel vers le secteur moderne, mais le rythme de cette dynamique sera faible.[8]

Par conséquent, le miracle asiatique peut être expliqué par le scénario 3, tandis que les performances de croissance des années 2000 en ASS seraient expliquées par le scénario 1. Ainsi donc, à partir de l'analyse ci-dessus, une question fondamentale se pose. Quels facteurs externes et internes agissent sur les firmes manufacturières en ASS? En répondant à cette interrogation, on espère fournir aux décideurs publics les instruments de politiques économiques nécessaires à l'industrialisation des pays de l'ASS.

[8] Le Tableau 2.1 est la version modifiée de celui de Rodrik (2016*a*).

Table 1.1: Les effets des conditions externes et internes sur la croissance et l'industrialisation

		Conditions Externes	
		Bonnes	Mauvaises
Conditions Internes	Mauvaises	CE & Pas d'Industrialisation	Pas de CE & Pas d'Industrialisation
	Bonnes	CE & Industrialisation	Pas de CE & Industrialisation

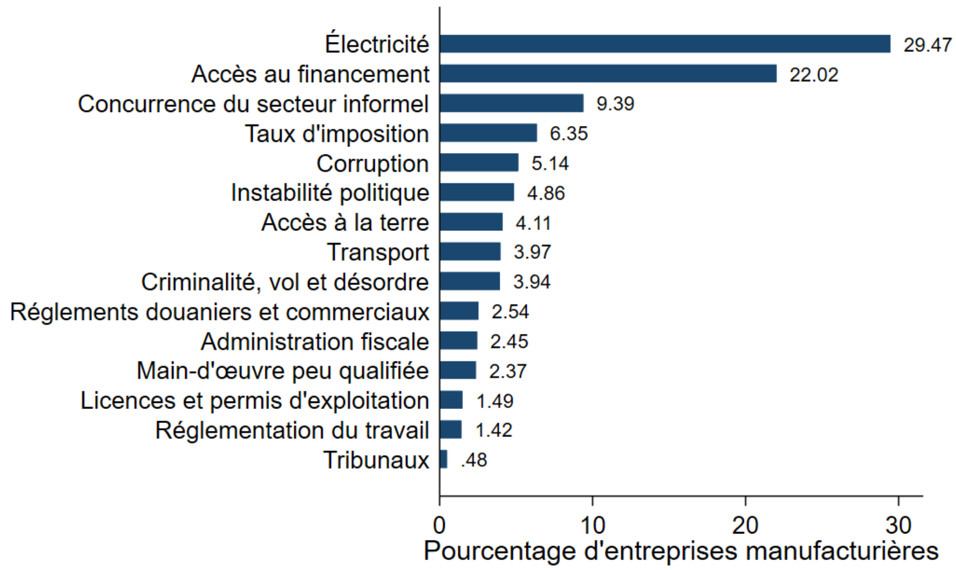
1.3 Quels déterminants pour l'industrialisation de l'Afrique?

L'objectif de la présente thèse est de deux ordres. Le premier est de comprendre les principaux déterminants de l'industrialisation de l'ASS (cette introduction générale vise à répondre à cette première interrogation). Le deuxième quant à lui est d'étudier empiriquement les effets de ces facteurs (chacun des chapitres, à part le chapitre 1, s'incrit dans ce travail empirique). Bien que plusieurs éléments puissent agir sur la croissance du secteur manufacturier, certains sont plus importants et sévères que d'autres. Pour saisir la prépondérance de quelques déterminants, il est indispensable de faire une hiérarchie des contraintes qui freinent l'expansion du secteur manufacturier. Selon les données de la World Bank Enterprise Surveys (WBES), les obstacles agissant négativement sur le développement des firmes manufacturières en ASS sont au nombre de 15 (Figure 1.10). Aux yeux des entreprises, certaines entraves semblent plus importantes que d'autres. En effet, plus de la moitié des firmes manufacturières (60,88%) trouve que les barrières liées à l'accès à l'électricité et au financement ainsi qu'à la concurrence du secteur informel sont les obstacles les plus importants à leur croissance. Plus précisément, la mauvaise qualité du service électrique se positionne comme la contrainte la plus citée par les entreprises (29,47% des firmes) suivie du manque d'accès au financement (22,02% des firmes) et de la concurrence du secteur informel (9,39% des firmes). En se focalisant sur ces trois obstacles, la présente thèse analyse les effets des contraintes internes et externes sur l'industrialisation des pays de l'ASS. S'il apparaît évident que l'électricité soit vue comme un déterminant interne, le rôle de déterminant externe de l'accès au financement et de la concurrence du secteur informel mérite de plus amples explications. En effet, les pays de l'ASS étant des économies en développement avec des taux d'épargne faibles, les fonds extérieurs, notamment ceux en provenance des économies avancées, apparaissent comme une source importante de financement. Cela est d'autant plus vrai que, dans certains cas, ces ressources externes peuvent servir à réduire les contraintes de liquidité au crédit. Partant de ce qui précède, la question de l'accès au financement est orientée vers la problématique de l'accès aux fonds extérieurs. La concurrence du secteur informel fait référence en partie à la pression concurrentielle exercée par les produits importés sur les entreprises manufacturières domestiques. Cette pression concurrentielle sera encore plus rude si les produits importés proviennent des pays développés capables de proposer des prix beaucoup plus compétitifs par rapport aux firmes manufacturières domestiques. Comme c'est le cas pour une grande majorité des pays de l'ASS, la spécialisation dans les exportations des ressources naturelles peut alimenter l'économie en devises étrangères qui, par le bais de l'appréciation de la monnaie locale peut rendre les produits manufacturés étrangers moins chers. A travers donc le canal des exportations et des importations, l'ouverture commerciale s'établit comme un facteur qui peut conséquemment agir sur l'industrialisation en ASS. Ainsi, les flux financiers et commerciaux entre l'ASS et le reste du monde sont considérés dans la présente thèse comme les principaux déterminants externes.

1.3.1 Déterminants internes de l'industrialisation de l'Afrique subsaharienne

Bien que plusieurs conditions internes puissent affecter la croissance manufacturière en ASS, au niveau macro-économique, les infrastructures semblent s'imposer comme les déterminants internes les plus importants. Selon Dethier (2015), en Afrique, la contribution des infrastructures à la croissance par tête est de 99 points de base contre 68 points de base pour les autres politiques structurelles. Au niveau entreprise, divers facteurs internes à l'instar du taux d'imposition, de la corruption et des instabilités politiques sont perçus comme les obstacles les plus importants à l'activité manufacturière de certaines firmes (Figure 1.10). Cependant, les con-

Figure 1.10: Les obstacles les plus importants à l'activité des firmes manufacturières en Afrique subsaharienne



Construction de l'auteur. Source : World Bank Enterprise Surveys.

traintes d'accès à l'électricité demeurent primordiales pour une grande majorité de ces entreprises. D'une part, 6,35%; 5,14%; et 4,86% des firmes trouvent respectivement que les facteurs internes ci-dessus hors l'électricité sont les obstacles les plus considérables. D'autre part, la proportion des entreprises manufacturières priorisant l'accès à l'électricité est de 29,27%.[9] De manière précise, il y a 4,61; 5,69; et 6,02 fois plus d'entreprises donnant la primauté aux contraintes d'électricité que de firmes priorisant respectivement les contraintes liées à la taxation et à la qualité des institutions.[10] Ainsi, la mauvaise qualité du service électrique apparaît plus préoccupante pour la plupart des entreprises en ASS comparée aux deux autres facteurs internes précités.

Par ailleurs, la faible qualité du service électrique s'avère primordiale pour les firmes manufacturières par rapport à d'autres infrastructures comme les routes

[9]Ces statistiques concernent les firmes qui trouvent que tel ou tel obstacle est le plus important parmi toutes les contraintes qu'elles subissent. Cela ne veut pas dire qu'elles négligent les autres obstacles. L'idée est de déclarer le plus urgent des obstacles, donc de faire une hiérarchisation des contraintes que les firmes subissent.

[10]La corruption et les instabilités politiques sont considérées dans le cas présent comme des mesures de la qualité des institutions.

Table 1.2: L'ampleur des contraintes liées à l'accès aux infrastructures à partir des données de la World Bank Enterprise Surveys

Obstacles liés à l'accès à l'électricité	**Nombre d'entreprises**	**Proportion d'entreprises**
Aucun obstacle	2226	14.55%
Obstacles mineurs	2410	15.76%
Obstacles modérés	2405	15.73%
Obstacles majeurs	4166	27.24%
Obstacles très graves	4029	26.34%
Obstacles liés aux transports	**Nombre d'entreprises**	**Proportion d'entreprises**
Aucun obstacle	4589	30.01%
Obstacles mineurs	3792	24.79%
Obstacles modérés	3164	20.69%
Obstacles majeurs	2543	16.63%
Obstacles très graves	1,052	6.88%
Obstacles liés aux télécommunications	**Nombre d'entreprises**	**Proportion d'entreprises**
Aucun obstacle	5670	44.81%
Obstacles mineurs	3543	28.00%
Obstacles modérés	1844	14.57%
Obstacles majeurs	1070	8.46%
Obstacles très graves	442	3.49%

et la télécommunication (Tableau 1.2). En effet, 53,58% des entreprises manufacturières en ASS déclarent que les entraves liées à l'accès à l'électricité sont délétères.[11] Toutefois, les entreprises qui affirment ceci pour les transports et les télécommunications représentent respectivement 23,51% et 11,95% des firmes enquêtées. Par conséquent, les entreprises considérant les obstacles inhérents à l'accès à l'électricité comme une urgence absolue sont deux et trois fois supérieures à celles qui considèrent respectivement les transports et les télécommunications comme des contraintes délétères. Par ailleurs, il y a seulement 14,55% des firmes qui ne font face à aucun obstacle lié à l'accès à l'électricité contre 30,01% et 44,81% des firmes qui trouvent qu'il n'y a pas de barrière respectivement aux services de transport et de télécommunication.

A partir du Tableau 1.3 ci-dessous, une analyse inter-régionale met en lumière deux singularités notables. Premièrement, comparée aux autres régions du monde, la population de l'ASS a le moins accès à l'électricité. Au moins 90% des popula-

[11] Cette statistique combine les firmes qui déclarent que les obstacles sont majeurs et celles qui trouvent qu'ils sont graves (voir Tableau 1.2). Elle ne signifie pas que l'entreprise considère la mauvaise qualité du service électrique comme la contrainte la plus importante. Elle permet juste aux firmes de donner l'ampleur des différents obstacles dont elles font face. L'objectif ici est de donner une hiérarchie de l'ampleur des obstacles non pas une hiérarchie des obstacles eux mêmes.

tions de toutes les autres régions du monde hors ASS ont accès à l'électricité, alors que seulement 46,75% de la population subsaharienne en a accès. Pourtant, certaines régions du monde comme l'Asie de l'Est et Pacifique (2.350.703.749) ainsi que l'Asie du Sud (1.835.776.769) ont des populations supérieures à celle de l'ASS (1.106.957.870). Deuxièmement, l'Afrique au sud du sahara s'avère être la région où l'accès à l'électricité entre les zones rurales et urbaines est le plus inégalitaire. Si au moins 90% des populations rurales et urbaines ont accès à l'électricité dans les autres régions du monde, une disparité frappante existe dans la région subsaharienne. Pendant que la part de la population urbaine ayant accès à l'électricité est de 77,86%, celle de la population rurale est de 28,06% en ASS. On pourrait être tenté d'expliquer une telle inégalité par le fait que la population rurale dans cette région est 1,46 fois supérieure à la population urbaine. Cependant, cette explication est peu convaincante dans la mesure où la population rurale d'Asie du Sud est à peu près deux fois supérieure à la population urbaine. De plus, bien que les populations urbaines dans les autres régions du monde soient largement supérieures aux populations rurales, le taux d'accès à l'électricité est au moins 90% de la population dans les deux zones.[12]

De ce qui précède, la première partie de la présente thèse s'intéressera aux impacts des infrastructures électriques sur les performances des firmes manufacturières en ASS. L'objectif sera de saisir comment la qualité du service électrique contribue à l'emploi des firmes manufacturières ainsi qu'au mouvement de celles-ci du marché domestique vers le marché des exportations.

1.3.2 Déterminants externes de l'industrialisation de l'Afrique subsaharienne

Selon la théorie néo-classique, les pays les moins industrialisés peuvent rattraper les nations les plus développées en tirant parti de leur retard. Étant donné le faible niveau du ratio capital-travail, le rendement de l'investissement est plus élevé dans les régions en développement que dans les économies développées. De ce fait,

[12]Dans le cas présent, le terme "les autres régions du monde" désigne toutes les régions hors ASS et Asie du Sud.

Table 1.3: Population et proportion de la population ayant accès à l'électricité à partir de la classification des régions de la Banque Mondiale

Région du monde	**Population totale**	**Accès à l'électricité (% population totale)**
Amérique du Nord	365.987.250	100
Europe et Asie centrale	920.806.339	99,99
Amérique latine et Caraïbes	646.430.786	98,42
Asie de l'Est et Pacifique	2.350.703.749	98,13
Moyen-Orient et Afrique du Nord	456.709.496	97,23
Asie du Sud	1.835.776.769	94,40
Afrique subsaharienne	1.106.957.870	46,75
Région du monde	**Population urbaine**	**Accès à l'électricité (% population urbaine)**
Amérique du Nord	301.433.350	100
Europe et Asie centrale	665.476.579	99,99
Asie du Sud	632.092.773	99,73
Amérique latine et Caraïbes	522.741.449	99,70
Moyen-Orient et Afrique du Nord	299.961.065	99,66
Asie de l'Est et Pacifique	1.407.811.694	99,13
Afrique subsaharienne	450.673.306	77,86
Région du monde	**Population totale**	**Accès à l'électricité (% population rurale)**
Amérique du Nord	64.553.900	100
Europe et Asie centrale	253.540.882	99,99
Asie de l'Est et Pacifique	942.892.055	96,64
Moyen-Orient et Afrique du Nord	156.748.431	93,90
Amérique latine et Caraïbes	123.651.335	93,00
Asie du Sud	1.203.683.996	91,60
Afrique subsaharienne	656.284.564	28,06

l'ouverture financière devrait favoriser les flux de capitaux des économies industrialisées vers les pays en développement afin de compenser la faiblesse de l'épargne intérieure. En concentrant ces capitaux dans le secteur manufacturier, on devrait assister à un rattrapage industriel des économies en développement à travers une forte croissance de la production manufacturière. En présence d'une sur-abondance de produits manufacturés et d'un besoin croissant en capital, l'ouverture commerciale permettra l'exportation du surplus d'offre et l'importation des capitaux physiques ainsi que des intrants intermédiaires. L'ouverture financière et commerciale apparaissent donc comme des moteurs d'industrialisation pour les pays les moins avancés comme ceux en ASS.

Les flux financiers internationaux comme déterminants externes de l'industrialisation de l'Afrique subsaharienne

Le pauvre accès au financement considéré par les firmes manufacturières sur la Figure 1.10 est confirmé au niveau macro-économique par le faible taux des crédits octroyés aux firmes en ASS. En effet, le crédit total accordé au secteur privé de cette région est de 39,93% du PIB (Tableau 1.4). Dans le cas spécifique du prêt octroyé par les banques, le taux de crédit au secteur privé est de 26,02% du PIB. Toutefois, les chiffres ci-dessus pourraient être plus faibles dans le cas du secteur manufacturier. Souvent, dans les pays où le secteur industriel est peu développé, les activités d'importation évincent l'entrepreneuriat dans le secteur manufacturier. Dans ce secteur, les banques ont tendance à accorder plus de crédits aux importateurs que de prêts destinés à l'investissement industriel. En plus de ceci, deux autres raisons peuvent expliquer l'intérêt des banques pour les activités d'importation et leur méfiance vis-à-vis des projets de création d'usine. Premièrement, le retour sur investissement d'une activité d'importation est beaucoup plus rapide que celui sur la création d'une usine qui peut, dans certains cas, s'étaler sur plusieurs années. Deuxièmement, les risques associés aux activités d'importation sont plus faibles que ceux associés aux investissements industriels. En revenant au Tableau 1.4, il apparaît que l'ASS est la région du monde où les banques octroient le moins de prêt au secteur privé. Le crédit intérieur (% PIB) fourni au secteur privé par les banques est près de deux fois plus élevé en Amérique latine et Caraïbes ainsi qu'en Asie du Sud comparé à l'ASS. En considérant l'Asie de l'Est et Pacifique comme région de comparaison, le taux de crédit par PIB y est 5,44 fois plus élevé qu'en ASS.

Face au faible taux de crédit intérieur destiné au secteur privé, les décideurs publics ont, pour la plupart misé sur les investissements directs étrangers (IDE). Comme l'expliquent Gui-Diby & Renard, les dernières décennies ont été marquées par l'implémentation des politiques visant à attirer les flux d'IDE en Afrique. D'ailleurs, au début des années 2000, la déclaration du millénaire des Nations Unies disait: «Nous [l'assemblée générale des Nations Unies]... Nous décidons également de prendre des mesures spéciales pour relever les défis de l'éradication de la pauvreté et du développement durable en Afrique, y compris..., le renforcement de l'aide publique au développement et l'augmentation des flux d'investissements directs étrangers,... (déclaration du millénaire des Nations Unies, 8 septembre 2000)». Malheureusement, au mieux, ces investissements étrangers n'ont pas eu d'effet sur l'industrialisation en Afrique, au pire, ils ont été une source de désindustrialisation (Gui-Diby & Renard, 2015). Comme le démontre Asiedu (2006), cet échec peut être expliqué par le fait que les IDE en Afrique sont essentiellement concentrés dans le secteur des ressources naturelles ce qui évince le secteur manufacturier. Concernant l'aide publique au développement (APD), elle est également une source de désindustrialisation en ASS car principalement orientée vers les secteurs non-échangeables (Rajan & Subramanian, 2008).

Au-delà des flux d'IDE et d'APD, les envois de fonds des migrants (EFM) africains sont devenus les principales sources de fonds extérieurs en ASS. Depuis 2015, la part des EFM dans le PIB a dépassé celle des IDE (Figure 1.11). En 2019, les fonds reçus des migrants subsahariens s'estimaient à 2,73% du PIB contre 1,75% pour les IDE. De plus, les EFM s'avèrent moins volatiles que les IDE. Enfin, sur les cinq dernières années, les EFM semblent entamer une dynamique de croissance alors que les IDE baissent dans le temps. Les fonds des migrants subsahariens seront les principales sources de financement extérieurs auxquelles cette thèse s'intéressera. Le but est de comprendre dans quelle mesure les EFM peuvent être un moteur

Table 1.4: Part du crédit intérieur (% PIB) fournie au secteur privé à partir de la classification des régions de la Banque Mondiale

Région du monde	**Crédit au secteur privé**	**Crédit par les banques**
Amérique du Nord	190,76	51,94
Asie de l'Est et Pacifique	155,53	141,55
Europe et Asie centrale	87,77	86,51
Amérique latine et Caraïbes	55,18	50,46
Asie du Sud	47,24	47,20
Afrique subsaharienne	39,93	26,02
Moyen-Orient et Afrique du Nord	Pas de données	Pas de données

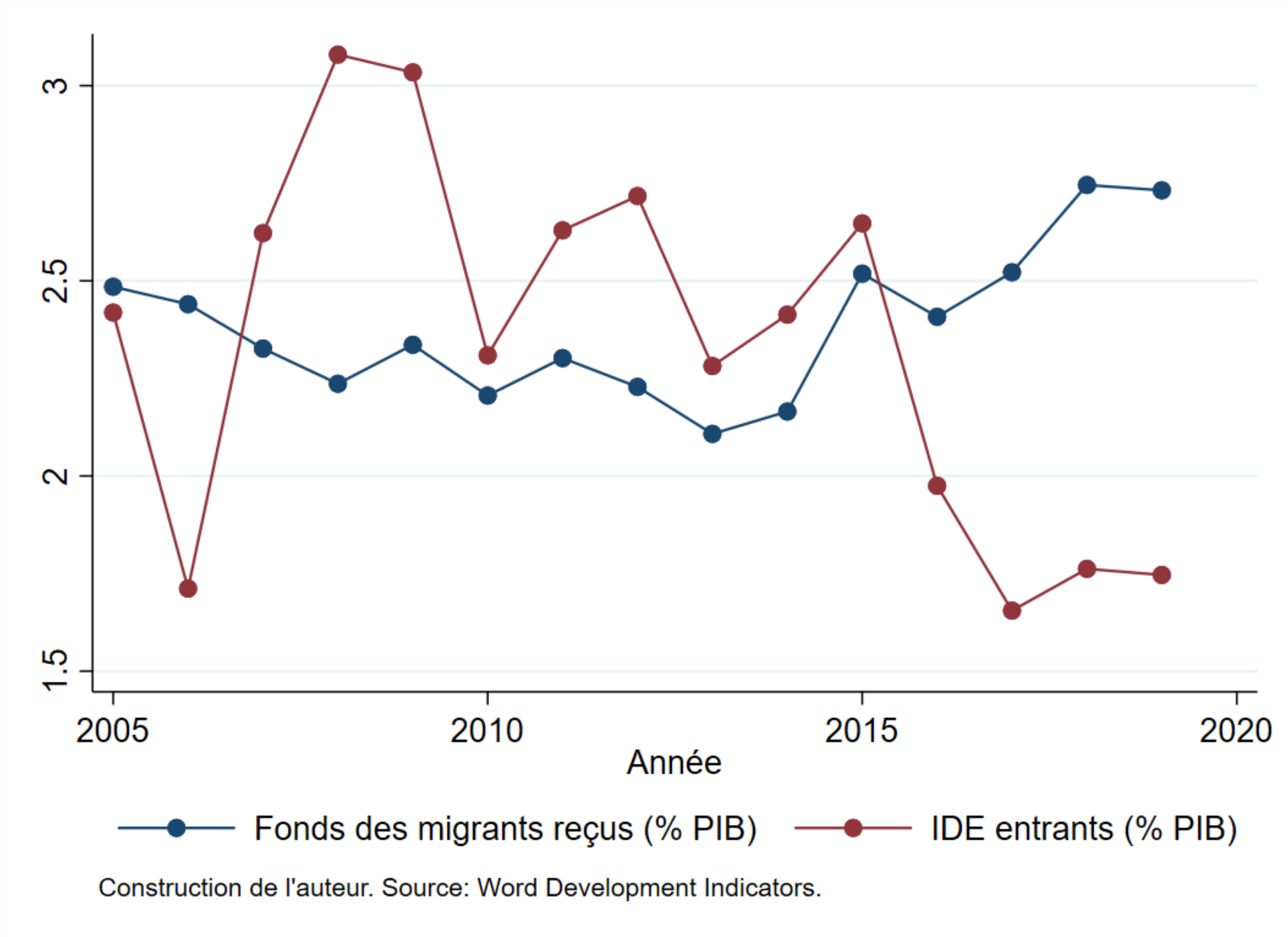
d'industrialisation en ASS contrairement aux IDE et aux APD.

Le commerce international comme déterminant externe de l'industrialisation de l'Afrique subsaharienne

Les politiques commerciales ont de tout temps été intrinsèquement liées aux stratégies d'industrialisation de la plupart des nations du monde. Des économies les plus industrialisées à celles les moins avancées, les politiques commerciales de protection et de libéralisation ont été chronologiquement imbriquées aux stratégies d'industrialisation (Chang, 2002; Levy, 1992). Par ailleurs, certaines différences substantielles dans l'application de ces politiques ont engendré des résultats distincts entre les économies.

L'évidence la plus récente et la plus saisissante du succès récent d'une catégorie de stratégies industrielles et de l'échec d'une autre est la réalité industrielle disparate entre l'Asie de l'Est et l'ASS. Au cours du XIXe siècle, les pays d'Asie, d'Afrique et d'Amérique latine ont connu un processus de désindustrialisation. Leur part totale dans la production manufacturière mondiale est passée de 60,5% en 1830 à 7,5% en 1913 (Nayyar, 2019). Cette désindustrialisation a ainsi été un phénomène commun à ces trois régions pendant leurs années respectives de colonisation. Par contre, la période 1970-2016 a été marquée par certaines divergences entre l'Afrique et l'Asie en termes d'industrialisation. Entre 1970-2016, la part de la VA manufacturière dans le PIB est passée de 10% à 23% en Asie, en même

Figure 1.11: Envois des fonds des migrants et investissements directs étrangers (% PIB)



temps, celle de l'Asie de l'Est dans la VA manufacturière mondiale est passée de 4% à 41% (Nayyar, 2019). En ASS, la VA manufacturière (% PIB) a chuté d'environ 13% en 1980 à 10% en 2016, avec une part dans la production manufacturière mondiale qui est passée de 3% en 1970 à moins de 2% en 2010 (Page et al. 2016). Par conséquent, il y a eu une transformation structurelle favorisant la croissance en Asie alors qu'elle l'a réduite en ASS (McMillan & Rodrik, 2011).

Une autre particularité entre les pays d'Asie et d'ASS réside dans les politiques industrielles et commerciales en tant que soutiens à l'industrialisation. Dans les années 1950 et 1960, certains pays asiatiques, comme de nombreux pays en développement, ont opté pour des politiques de protection commerciale en raison de la désindustrialisation de la période coloniale. D'une part, ces stratégies commerciales ont consisté en des politiques de substitution aux importations visant à protéger le développement du secteur manufacturier local. D'autre part, elles se sont matérialisées par une intervention accrue de l'État afin de guider les firmes vers les industries manufacturières à forte intensité de main-d'oeuvre (Lin, 2009). Bien que la grande majorité de ces pays se soient ouverts au commerce international au cours des années 1980, leur singularité réside dans la modification progressive du contenu de leurs exportations. Dans certains cas, ils ont commencé à exporter des matières premières agricoles, puis une part importante de ces exportations s'est progressivement constituée de produits manufacturés à forte intensité de main-d'oeuvre, ensuite de biens manufacturés à forte intensité de capital. Après leur indépendance, certains dirigeants d'ASS ont eu l'ambition d'industrialiser leur pays pour ne plus dépendre de leur ancienne puissance coloniale. Leur idée était de créer les mêmes industries à forte intensité de capital que dans les pays développés. Ces politiques se sont d'abord accompagnées d'un dynamisme industriel dans certains pays d'ASS. En 1960, la part de la VA manufacturière dans le PIB était de 9%, 10%, 14%, 16% et 20% respectivement au Kenya, Sénégal, Congo, Zimbabwe et en Afrique du Sud (Austin et al., 2016). Pour de nombreux pays d'ASS, la fin des années 1980 a été marquée par une ouverture commerciale qui leur a permise d'exporter des ressources naturelles minérales et agricoles avec un faible taux de diversification. Dans ces conditions, le taux de croissance annuel du secteur manufacturier, qui était de 8% entre 1961-1970 en ASS, a été réduit à 5,1%, 1,9% et 1,1% respectivement entre 1971-1980, 1981-1990 et 1991-2000.

À un moment donné de leur histoire, l'Asie et l'ASS ont d'abord mis en oeuvre des politiques de protection commerciale, puis d'ouverture commerciale. Cependant, les mesures commerciales prises par les gouvernements de ces deux régions ont été différentes ainsi que leurs résultats en termes d'industrialisation. De ce fait, la deuxième partie de cette thèse se consacrera à comprendre comment l'ouverture commerciale et la politique industrielle expliquent la nature et le sens d'une transformation structurelle.

1.4 Les mesures du changement structurel et de l'industrialisation

La transformation structurelle, par définition, est l'allocation de l'activité économique entre les secteurs d'activité. Pour Lewis (1954), une telle allocation des ressources concerne principalement le secteur à faible productivité (l'agriculture et les services informels) et celui à productivité élevée (la manufacture). Cependant, avec la naissance des services hautement technologiques, la définition du CS a changé.[13] En ne considérant plus les services comme une activité informelle, Herrendorf et al. (2014) définissent la transformation structurelle comme le mouvement des ressources entre l'agriculture, la manufacture et les services. Partant de cette définition, la littérature a mis en lumière deux groupes de mesures du CS. Le premier concerne les indicateurs du côté de la production (les VA et les emplois sectoriels) et le deuxième se réfère à ceux du côté de la consommation (les dépenses de consommation sectorielle).[14] Ainsi, le CS se manifestera par la hausse ou la baisse des VA des emplois et des dépenses de consommation (DC) dans les différents secteurs. Selon d'autres auteurs, il ne saurait y avoir de transformation structurelle que si les parts des VA et des DC sectorielles (% PIB) ainsi que la part des emplois sec-

[13]Par services hautement technologiques, j'entends toutes les nouvelles technologies de l'information et de la communication ainsi que la finance.

[14]Voir Herrendorf et al. (2014).

toriels (% emploi total) évoluent (Rodrik, 2016*b*; Gui-Diby & Renard, 2015; Kang & Lee, 2011). Au-delà de cette divergence mineure, l'ensemble de ces mesures permet d'étudier le CS à travers une analyse statistique qui consiste à observer l'évolution temporelle de chaque dimension dans différents secteurs. Cependant, la limite principale de la présente littérature provient du fait qu'elle ne fournit pas un indicateur qui reflète à lui seul les évolutions de plusieurs secteurs. Sans un tel indicateur, il dévient compliqué d'étudier les déterminants du CS à travers un modèle économétrique imposant l'existence d'une variable dépendante. Pour palier cela, la présente thèse suggère des indicateurs de CS qui correspondent aux ratios entre les différentes mesures de transformation structurelle mentionnées ci-dessus. Par exemple, le CS entre l'agriculture et l'industrie se mesurera par le ratio entre leurs VA ou par le ratio entre leurs emplois. Une telle mesure peut être aisément utilisée comme variable dépendante dans un modèle économétrique qui vise à étudier empiriquement les déterminants de la transformation structurelle.

Analogiquement, l'industrialisation sera mesurée par la part de la VA de la manufacture (% PIB) et par celle de l'emploi manufacturier dans l'emploi total. Si les travaux ci-dessus ont mis en lumière des indicateurs macro-économiques du CS et de l'industrialisation, ils en disent peu sur les mesures de l'industrialisation au niveau entreprise. Dans le cadre de cette thèse, je propose que l'industrialisation, au niveau entreprise, soit mesurée à travers deux étapes. Premièrement, il faut considérer l'ensemble des entreprises qui opèrent dans le secteur manufacturier. En effet, il est important de faire la différence entre l'industrie et la manufacture. Selon la définition de la Banque Mondiale, l'industrie regroupe les mines, la construction, l'électricité, l'eau, le gaz et la manufacture. L'industrie correspond donc aux divisions 05-43 de: International Standard of Industrial Classification (ISIC). Clairement, cette définition de l'industrie prend en compte des activités qui n'ont rien à voir avec l'industrialisation dans sa définition historique (la transformation des matières premières en produits plus ou moins finis). En tant que tel, la manufacture est le secteur historique de l'industrialisation en ce sens que la révolution industrielle y a pris naissance. Dans une seconde étape, les mesures traditionnelles de la performance des entreprises sont estimées comme des mesures de l'industrialisation. Plus précisément, les ventes totales, les ventes domestiques, les exportations, l'emploi et l'accumulation du capital dans les firmes manufacturières sont considérés comme les principales mesures de l'industrialisation au niveau entreprise.

1.5 Conclusion

Bien que l'objectif central des économistes du développement soit de trouver la formule de la prospérité économique des nations, il n'y a pas encore de consensus autour de la recette du développement économique. Si certains auteurs mettent en avant le rôle de la qualité des institutions, d'autres désignent le commerce et la situation géographique comme les facteurs principaux des écarts de niveau de vie entre les pays. Néanmoins, l'industrialisation est la caractéristique commune à la plupart des économies avancées. En termes de croissance industrielle, l'Afrique subsaharienne est la région du monde la plus en retard, ce qui explique son niveau d'incidence de pauvreté encore très élevé. La nécessité pour cette région de s'industrialiser dévient de plus en plus urgente en ce sens que sa population croit à un rythme effréné. Dans cet ordre d'idées, la présente thèse étudie empiriquement les effets des facteurs internes et externes sur le processus d'industrialisation de l'Afrique subsaharienne. Les déterminants internes désignent les infrastructures électriques qui représentent les contraintes les plus importantes aux yeux des firmes manufacturières. Les déterminants externes concernent d'une part, les flux financiers et d'autre part, le commerce international. Étant donné que les investissements directs étrangers sont, depuis 2015, moins importants que les envois de fonds des migrants, ces derniers seront les principales sources de financement extérieur étudiées dans cette thèse. On peut ajouter que les investissements directs étrangers ont échoué à industrialiser l'Afrique car orientés vers des activités qui évincent le secteur manufacturier. De plus, tout au long de l'analyse des effets du commerce international sur l'industrialisation, un accent particulier sera mis sur les différences de politiques commerciales entre l'Afrique subsaharienne et l'Asie de l'Est.

PART I : Internal Determinants of Industrialization in sub-Saharan Africa.

Chapter 2

Infrastructure and Manufacturing Employment

Abstract

The youth population of Africa would double by 2050, with a labor market that would welcome 29 million people every year by 2030. Meanwhile, manufacturing firms in this region are experiencing a number of constraints that adversely affect their business, power outages being the most serious obstacle. Using the instrumental variables approach with fixed effects, this paper studies the impact of production losses due to power outages on employment in a large sample of manufacturing firms. More precisely, 15,306 manufacturing firms operating in 43 sub-Saharan African countries are studied. The results indicate that production losses due to power outages negatively affect total workers, production workers, temporary employees, unskilled and skilled workers. However, the impact on non-production employees is positive. Temporary and unskilled workers are the most vulnerable to production losses due to electricity shortages. The effects are economically substantial because the elasticities of output losses account for a large share of the standard deviation of temporary, unskilled and skilled employees. Heterogeneity tests reveal that the use of generators has a deleterious effect on workers.

2.1 Introduction

The movement of labor from traditional sectors (agriculture and other informal activities) to the modern sector (manufacturing) is the unconditional growth path to economic development (Herrendorf et al. 2014; Kuznets & Murphy, 1966; Lewis, 1954).[1] This process, defined as structural change, increases total factor productivity (TFP) because labor moves from the low to the high productivity sector. As a result, the rise of TFP will lead to an augmentation of income, which will improve the standard of living. Despite the role of structural change in improving living standards, sub-Saharan Africa (SSA) lags behind all other regions in terms of labor allocation to the manufacturing sector.[2] Indeed, in 2019, more than 50% and 30% of the workforce were concentrated in the agricultural and service sectors, respectively (Figure 2.1). The share of industry in total employment was only 10.69%, and this figure may be even lower in the case of manufacturing sector.[3] In addition to being the least employed sector, manufacturing is the most unequal sector in terms of employment (Figure 2.2). Women working in industry account for 7.63% of the total female employment in SSA, while the share of men in industry is 13.19% of the total male employment. Consequently, the gap between men and women in terms of proportion by gender is 5.56%. This difference is 6.12% in the service sector, but in favor of women. Finally, agriculture is the most equitable sector with a negligible gap of 0.46%. A development of the manufacturing sector that will create a substantial number of jobs for young Africans seems to be an obligation and emergency for SSA. For instance, more than one-fifth of the world population - 2 billion people - would be located in Africa by 2050 (AfDB, 2017). This region would also have the largest and youngest workforce in the world by 2025, with 500 million people in its labor market. Since the youth population in Africa would double in 2050, its labor market would welcome 29 million young peo-

[1] The unconditional growth refers to an economic expansion of country despite its institutional quality and geographical location (see Rodrik, 2016*a*).

[2] SSA refers to sub-Saharan Africa, but sometimes it is used to say SSA countries, i.e., sub-Saharan African countries.

[3] The industrial sector includes manufacturing, mining and quarrying, construction, and public utilities, according to WDI. However, this paper focuses only on the manufacturing industry. Some statistics for industry, such as those related to employment, are only considered because data for manufacturing are not available.

ple each year until 2030 (AfDB, 2017). The challenge for SSA policymakers in the future is, therefore, to make the manufacturing sector capable of absorbing labor that may come from the traditional sector.

The lack of unskilled labor movement towards manufacturing has been explained by the absence of productivity growth in the traditional sector, particularly agriculture (Collier & Dercon, 2014). In this sense, most policymakers in SSA have focused on the modernization of agriculture through investment in inputs. However, the reasons that make manufacturing firms less willing to welcome workers from the agriculture sector are little studied. Clearly, the first step of structural transformation starts with agricultural productivity growth, freeing up labor for manufacturing activities. Nevertheless, manufacturing firms would absorb this workforce if the constraints related to their activities are limited or completely removed.[4] Some internal factors, such as the poor quality of electricity service are important in the transition of SSA economies to the manufacturing sector. Indeed, electricity integrates manufacturing production as an input, contributing to firms' productivity. Hence, the poor quality of electricity supply could be a source of productivity and production losses that may adversely impact the willingness of firms to hire while forcing them to dismiss some workers. The issue of the poor quality of electricity service is very critical in SSA for three main reasons. First, SSA is the region of the world with the lowest access to electricity per population. Over 90% of the population in other regions of the world has access to electricity, this proportion is only 46.75% in SSA (Figure 2.3). In addition to low access to electricity, the allocation of electricity between rural and urban areas in SSA is the most unequal in the world. In other regions of the world, more than 90% of rural and urban populations have access to electricity (Figure 2.4 & Figure 2.5). However, in SSA, only 28.06% of rural populations have access to electricity compared to 77.86% of urban populations (Figure 2.4 & Figure 2.5). Third, regarding the poor quality of electricity service, it appears in the top 2 of obstacles that adversely affect the activity of firms in SSA. An important sectoral difference can be noted. In the manufacturing sector, 29.47% of firms report that electricity is the most important constraint

[4]The terms firm, enterprise and company are used alternately in this paper.

they face (Figure 2.6), compared to 22.02% of firms for constraints related to access to finance (Figure 2.7). In the non-manufacturing sector, Figure 2.8 & 2.9 show that barriers associated with access to finance (20.47% of firms) become the most important, followed by obstacles associated with electricity (18.97% of firms). In contrast, in other developing countries, electricity is only the 5th and 7th most important constraint affecting manufacturing and non-manufacturing firms, respectively (Figure 2.10 & Figure 2.12).

This paper aims to study how the poor quality of electricity service, the most important obstacle to the manufacturing activity, affects employment in manufacturing firms. More precisely, it explores the impact of production losses due to power outages on jobs in 15,306 manufacturing firms operating in 43 SSA countries. For this purpose, the instrumental variables approach with country and industry fixed effects (IVFE) is applied. Power losses during the transmission and transportation of electricity between the sources of supply and the points of distribution are used as instrument.

This paper can be related to three waves of literature poorly explored. The first wave considers the link between electricity infrastructure and employment in African firms. Mensah (2018) is one of very few papers that addresses this link. The author studies the impact of power outages - length and number - on employment within firms in Africa. However, he does not consider production losses due to power outages and does not examine the specific case of the manufacturing sector.[5] The point is, the effect of the length and number of electricity shortages on employment occurs only through production losses. Indeed, the response of companies to power outages in terms of employment depends on whether these shortages result in significant production losses or not. When production losses are significant enough to reduce the marginal productivity relative to the marginal wage, firms might respond by reducing the marginal wage to the level of the new marginal productivity. This reduction of wages could, for example, be manifested by laying off workers. However, for a few seconds of outages or for a negligible number of outages that do not lead to significant production losses, the response of firms in

[5]The terms power outages and electricity shortages are used alternately in this paper.

terms of employment's reorganization may be negligible. So what really matters is the production loss due to power outages, not the number or length of electricity shortages. Therefore, the paper contributes to this first wave of literature by using a variable of production loss due to power outages rather than the length and number of outages. Also, I contribute to this first part of literature by focusing only on the case of manufacturing sector, which allows providing one of the explanations for the lack of structural transformation in SSA. The second wave of literature investigates the effect of power outages on firms' performance like productivity, sales, and investment (Cole et al. 2018; Allcott et al. 2016; Fisher-Vanden et al., 2015; Alam 2013; Steinbuks & Foster, 2010; Reinikka & Svensson, 2002). Compared to this second wave, this research contributes to the literature by studying how the quality of electricity service affects other manufacturing firms' performance in SSA, namely employment. The third wave of literature studies how access to electricity within households frees up workforce for labor market (Akpandjar & Kitchens 2017; Grogan & Sadanand 2013; Dinkelman, 2011; Coen-Pirani et al. 2010; Ramey & Francis 2009). Thus, I study if labor from households due to electricity availability could be absorbed or not by manufacturing firms.

Using the IVFE method, I find that production losses due to power outages in percentage of total sales negatively affect overall employees, positively impact non-production workers and negatively affect production employees. A 1 percentage point increase in production losses to sales reduces the number of total workers by 0.12 percentage points, increases non-production employment by 0.72 percentage points and reduces production employees by 0.26 percentage points. Hence, the negative effect of production losses on total workers occurs only through production employees. Consequently, the latter category of workers is classified into two groups: skilled and unskilled employees. The results reveal that temporary and unskilled workers are more vulnerable to production losses due to power outages compared to skilled employees. More precisely, a 1 percentage point increase in production losses reduces the number of temporary, unskilled and skilled workers by 0.53, 0.36, and 0.22 percentage points, respectively. The above effects are economically substantial because the elasticities of output losses account for a large share of the standard deviation of employment variables. Heterogeneity tests in relation to self-generation show that the use of generators at a given threshold (more than 50% of the electricity consumed) has a deleterious effect on temporary, unskilled and skilled workers. The previous findings are confirmed in part by the use of multi-level regressions and local measures of firms' responses.

Finally, the rest of this paper is organized as follows: the theoretical framework is presented in Section 2.2; Section 2.4 describes data and variables; the empirical strategy is in Section 2.5; the results will be interpreted in Section 2.6; heterogeneity tests are shown in Section 2.7; the robustness check is presented in Section 2.8; and Section 2.9 will be the concluding remarks.

2.2 Theoretical framework

The question is: how do production losses due to power outages affect employment in manufacturing firms? According to the neoclassical theory, as long as the marginal productivity of labor is greater than or equal to the marginal wage, firms will continue to hire. However, when a power outage occurs, the production machines and other equipment that rely on electricity become non-operational. The employees working on these machines will be without tasks to perform during their working hours. As a result, there will be losses in labor productivity leading to production losses. In response to the productivity losses, firms should reduce the marginal wage by either lowering the nominal wages of employees or by reducing the number of workers. Since in many countries, firms are constrained by a minimum wage level below which they cannot pay their employees, laying off workers becomes the most obvious option. Hence, the response of firms with complementary factors of production will depend on the time horizon.

In the short term, companies will substitute the intermediate inputs for electricity (Fisher-Vanden et al. 2015). Instead of producing inputs from raw materials, firms will buy them. Although outsourcing has some costs, it still helps avoid productivity loss (Fisher-Vanden et al. 2015). Thus, the workers producing these intermediate inputs could be dismissed. The companies will schedule their production to the hours of electricity availability by operating only the machines that produce the final goods.

In the long term, companies will produce their own electricity by adopting a generator (Fisher-Vanden et al. 2015). Although generating its own electricity can prevent enterprises from production losses due to power outages while protecting employees from dismissal, self-generation imposes huge transaction costs to companies. For example, electricity from self-generation is 300% more expensive than public electricity in Africa (Dethier, 2015). In the specific case of Nigeria, 20-30% of initial investment is allocated to improve the electricity supply's reliability. To avoid these transaction costs, firms could reduce labor costs by laying off some workers. This effect on employment could be aggravated if the electrical capacity of self-generation is lower than that of public electricity. In this case, it can be assumed that the energy generation from generators fails to power all the production machines compared to the public grid. Consequently, it will result in dismissing the employees working on production machines that are no longer operational due to the low electrical capacity of self-generation. To summarize, two opposite effects of self-generation on employment can be clearly identified. On the one hand, the use of generators, by limiting productivity losses due to power outages, would limit employee layoffs. On the other hand, the transaction costs associated with self-generation would expose workers to layoffs that could be substantial if the transaction costs are significant. For now, let the empirical estimates show which effect prevails.

As production losses due to power outages could encourage many manufacturing companies to dismiss workers, what category of employees will be affected? Given the heavy dependence of production machines on electricity in manufacturing firms, workers in the production unit should be more affected by layoffs than workers in the non-production unit. There may even be a positive effect of power outages on non-production employees, because of the substitutability between labor and particular tools in the non-production unit. Indeed, some of the counting and tidying tasks performed by computers can be performed by labor, although to a less productive extent. In addition, temporary workers and unskilled employees should be more vulnerable to layoffs caused by production losses. The vulnerability of temporary workers is explained by the fact that, in the context of a negative shock like production losses due to power outages, it is easier for companies to dismiss workers with short-term contracts. Indeed, they are often not represented by trade unions and are not covered by labor laws applicable to workers employed on long-term contracts. The vulnerability of unskilled workers is explained by the fact that, in a context of falling production due to productivity declines, and to not further reduce total factor productivity, firms would choose to layoff the least skilled employees more than skilled employees.

For firms in which the production equipment and labor are substitute, they could make their production structure less intensive in electricity and capital and more intensive in labor. Indeed, firms may replace the production machines with more workers. By substituting capital for labor, companies may prefer more skilled workers to make up for productivity losses. However, companies in this situation are few because it is challenging to replace machines with the manual dexterity in manufacturing firms.

2.3 Is the 2000s economic growth in sub-Saharan Africa a story of industrial growth?

This section makes an analysis of the recent economic expansion and the manufacturing evolution in SSA. The aim is to understand if the economic growth performance in the 2000s was a manufacturing growth story or not. This section analyzes if manufacturing firms would have absorbed the decline in the share of agricultural employment in total employment during this period of economic growth. The beginning of the 2000s was marked by a resurgence of economic growth in many SSA countries. This unprecedented performance since the period of independence has highlighted a striking contrast. A striking contrast between a new Africa with one of the highest economic growth rates in the world and an Africa that has recorded a permanent decline in living standards in the 1980s. This has fuelled the debates about a possible African ”miracle” like East Asian countries (Rodrik, 2016*a*). The term ”miracle” in the case of Africa refers to the fact that it has been able to move out of a negative GDP per capita growth trap in the 1980s-2000s into positive growth. In SSA, the average GDP per capita growth was -1% and -0.70% during 1980-1990 and 1990-2000, respectively (Figure 2.10). Between 2000-2010, this growth reached 3% while it decreased after 2010 which raises doubts about its sustainability (Figure 2.10). As Rodrik (2016*a*) explains, although this surge in growth cannot be compared to that experienced by East Asian countries, it remains a better performance compared to Latin America. This solid economic growth in SSA is especially interesting given that the agricultural employment in total employment has declined by 9.03% between 2000 and 2018 (Figure 2.11). From the above, an important question emerges. Is the strong economic growth in SSA a result of manufacturing expansion? If so, we should expect a positive correlation between economic growth and manufacturing progress. According to Murphy et al. (1989*b*), most stories of strong growth in GDP per capita improving living standards are supported by manufacturing therefore by industrialization. However, this does not seem to be the case in SSA. When the growth of GDP per capita was on a positive path between 2000-2010, that of the share of manufacturing value-added in GDP was on a negative path (Figure 2.12). Although this period is not that of the Asian miracle, it can be seen that its growth of GDP per-capita and that of the share of manufacturing value-added in GDP were both on a positive path (Figure 2.12). Moreover, the economic expansion in SSA was not followed by a movement of labor towards industrial sector although employment in agriculture has declined in this period. Over the period 2000-2010, the growth rate of the share of industrial employment in total employment was on a negative path contrary to East Asia (Figure 2.13).[6]

The above graphs show an important reality in SSA. Indeed, the recent economic performance in SSA was not a story of manufacturing growth, and the decline of employment in agriculture seems to be not absorbed by the industrial sec-

[6]Industrial employment is represented in Figure 2.13 because the macroeconomic data of manufacturing employment for all SSA countries is not available in the public database.

tor. This raises two main questions. First, if the growth of the 2000s is not a story of manufacturing growth, what explains this unprecedented economic performance in SSA? Second, given that the growth in industrial employment was negative between 2000-2010, one might ask why firms in this sector, explicitly manufacturing firms are not able to absorb labor from informal sectors? Regarding the first question, it should be noted that the 2000s were marked by some external conditions that were favorable for SSA economies. According to Rodrik (2016*a*), they have benefited from high commodity prices, low-interest rates, and rising remittances. Also, SSA has benefited from China's rapid economic growth, which has led to strong demand for its natural resources. The reduction in growth could thus be explained by the gradual disappearance of these favorable external conditions. The second question could be explained by the internal constraints namely infrastructure obstacles that firms experience.[7] In summary, depending on the internal and external conditions, there are four scenarios of growth and structural change (SC).

- **Scenario 1:** If the external conditions are good while the internal ones are bad, there will be an episodic growth (EG) which will be reduced if the external conditions disappear. Because of the bad internal conditions, there could be a lack of SC, at worst, a labor movement from manufacturing firms to the traditional sector. Indeed, if there are some infrastructural constraints hampering industrial activity, firms will suffer from productivity losses and transaction costs, making them less willing to welcome workers especially unskilled labor from informal sectors. At worst, they could lay off this type of worker to reduce the costs generated by the infrastructural constraints. If the external conditions favor other sectors like that of raw materials (agricultural and mineral raw materials), the movement of labor towards these sectors will be accelerated, for example, the phenomenon of Dutch disease.

- **Scenario 2:** If the external and internal conditions are both bad, there will be neither EG nor SC. Bad external conditions will worsen the internal constraints that could increase the transaction costs of manufacturing firms and,

[7] The constraints imposed by the infrastructure, especially the electrical ones, are discussed in the introduction.

consequently, accelerate deindustrialization. Very high transaction costs or productivity losses for firms may lead to a layoff of workers who will take refuge in the informal sector.

- **Scenario 3:** If the external and internal conditions are both good, the EG will accelerate the pace of SC towards industrialization due to the good internal conditions. This last scenario leads to a miracle of growth, leading to a real process of industrialization and catching up.

- **Scenario 4:** If the external conditions are bad and the internal ones are good, there will be no EG while there is a SC towards industrialization. However, the poor external conditions could reduce the pace of SC. In this scenario, the direction of SC will not change - the movement of labor will be from the traditional sector to the modern sector - but, its pace.[8]

Table 2.1: The effect of external and internal conditions on growth and structural change

		External Conditions	
		Good	Bad
Internal Conditions	Bad	EG & No SC	No EG & No SC
	Good	EG & SC	No EG & SC

As a result, the Asian miracle can be explained by scenario 3, while the growth performance of the 2000s in SSA would be explained by scenario 1. Thus, from the above analysis, a fundamental question arises. What external and internal factors affect manufacturing firms in SSA? Answering this question gives economic policy tools to policymakers needed to industrialize SSA countries.

[8]Table 2.1 is the modified version of that in Rodrik (2016*a*).

2.4 Variable and data description

This section focuses on the description of variables and data.

2.4.1 Variable description

In order to have a comprehensive model, firm and country data are considered. The enterprise variables come from the World Bank Enterprise Surveys (WBES), which consider some questions on the business environment and other determinants of firms' performance. The surveys are carried out in each country on formal enterprises with stratified random sampling. The stratification is based on the sector of firms, their size, and geographical location. Data are collected by the statistical office of countries in which firms operate. The most recent standardized dataset over the period 2006-2020 is used. It contains 91,902 manufacturing enterprises operating in 150 developing countries. Thus, 15,306 manufacturing firms in 43 SSA countries are studied.

Firm data

- **Employment variables**: The total employment is measured by the number of permanent and full-time employees. This group of workers includes all paid employees who are hired for one or more fiscal years. They also include those with a guarantee of renewal of their employment and work at least 8 hours per day. Then, to study the impact of the variable of interest on the structure of employment, the total employment is decomposed into production and non-production workers. The production employment is measured by the number of permanent and full-time employees in the production area. This group of workers includes all employees engaged in manufacturing, processing, assembly, inspection, receiving, storage, handling, packaging, storage, shipping (without delivery), maintenance, repair, product development, auxiliary production for the plant's use, record keeping and other closely related services with production operations. The non-production employment is measured by the number of permanent and full-time employees in the non-production area.

This group of workers includes all employees not engaged in the production operations previously mentioned. Since the interest is in the manufacturing production activity, the production employment is classified into skilled and unskilled employment. Skilled employment is measured by the number of permanent and full-time employees who are skilled production workers. The permanent and full-time production workers are considered skilled if they have special knowledge or experience (usually acquired) in their work. A skilled worker may have attended college, university, or technical school. He or she may also be a worker who has acquired skills on the job. Unskilled employment is measured by the number of permanent and full-time unskilled production workers. A permanent and full-time production employee is considered unskilled if he or she does not have specific training, education, or skills to do his or her job. The temporary employment is measured by the number of full-time temporary employees. This group of workers includes all employees paid on a short-term contract (less than one fiscal year), with no guarantee of renewal of the employment contract, and who work 40 hours or more per week for the duration of their contract.

- **Production losses due to power outages**: It is estimated by the manager as the annual monetary value of production losses due to electricity shortages per sale. The monetary losses of production also includes the damage of equipment caused by power outages, as well as the cost of restarting the equipment.

- **Ownership**: These variables are measured by the shares of firms' capital that is held by domestic private agents, foreign agents, and government. Hence, they make it possible to consider hiring policy heterogeneities depending on whether a firm is essentially owned by domestic private agents, foreigners or by the government. Such differences between these economic agents can also affect the structure of employment, particularly in terms of preferences between skilled and unskilled workers.

- **Size**: The firms' size is controlled because the hiring policy may differ between large, medium, and small enterprises. Small companies have fewer than 20 workers, medium firms have between 20 and 99 workers, and large enterprises have 100 or more workers.

- **Employment (t-3)**: It is the number of permanent and full-time employees during the three-year period preceding the survey. The effect of this variable is controlled because a change in the hiring policy three years ago could have an impact on employment today. The variable thus makes it possible to take into account the persistence phenomena that firms are subject to.

- **Sales (t-3)**: It represents the total amount of sales during the three-year period preceding the survey. Firms that experienced good sales performance three years ago could use a portion of the earnings to hire more people in order to produce more. In the opposite case, they could be forced to stop hiring, to lay off some of the employees or in the extreme case of bankruptcy to dismiss all workers. Through this variable, the phenomena of persistence on the sales side are controlled.

- **Access to finance**: This variable refers to whether or not the firm has a line of credit in a financial institution. It is the answer to the following question: does the firm have a line of credit or a loan in a financial institution? As such, the impact of the access to finance on manufacturing employment can be controlled.

- **Transport infrastructure**: The quality of the transport infrastructure is measured by the magnitude of the barrier to its service. It is measured by the subjective answer given by the firm to the question: how much of a barrier is transportation to the activity of this establishment? The response is: 0 for no obstacle, 1 for minor obstacle, 2 for moderate obstacle, 3 for major obstacle, and 4 for very severe obstacle. Only the "severe obstacle" dimension is introduced into the estimates.

- **Labor market regulation**: The impact of labor market regulations is studied because they could be important determinants of firms' hiring policies.

The variable considered is a subjective answer given by the firm to the question: how much do labor regulations constitute an obstacle to the activity of this establishment? As for transport infrastructure, only the dimension "severe obstacle" is introduced in the estimates

- **Market connection**: Access to the international market on both the supply and demand sides could affect the hiring policy of firms through imports and exports. A firm that imports most of its inputs from outside could be different - in terms of employment policy - from an enterprise buying its inputs in the national economy. If the imported inputs are highly technological, firms could hire more skilled workers. Also, a company that exports a significant part of its production might be different from one that sells only in the domestic economy. The entry of an enterprise into the export market may require an increase in its productivity due to competition in the international market (Aw et al., 2000). This could be done either by purchasing more technological capital or by hiring more skilled workers, or both simultaneously. In this way, the effect of the share of foreign input in the total purchase of inputs and the share of sales exported in total sales are controlled.

Macroeconomic data

All the country-level variables except the instrument are lagged by one year to avoid any possible reverse causality between them and the employment variables. The growth of GDP and that of GDP per capita as well as foreign direct investment (FDI) and power losses are from the WDI. The trade openness indicator comes from the KOF Swiss Economic Institute database.

- **Power losses in % of total electricity production**: This variable measures the share of annual power losses in the total number of gigawatt hours (GWh) produced. These losses are recorded during the transmission and transportation of electricity between the sources of supply and the points of distribution including distribution to consumers. To allow for some variability, I compute its growth rate and use it as an instrument.

- **GDP growth (t-1)**: Since GDP is, in part, the sum of value-added, its growth could be due to an increase in the production of some firms. Thus, one might expect an increase in employment within these enterprises. However, GDP growth may not have a significant impact on manufacturing employment if it is driven by non-manufacturing firms. Furthermore, it could have a negative effect on manufacturing employment if it is due to an increase in the natural resources production. In the context of Dutch disease, labor moves from manufacturing to the natural resources sector.

- **GDP per capita growth (t-1)**: It measures market size, the growth of which creates investment opportunities through the intensive and extensive margin. For the intensive margin, firms already in the market would increase their demand for factors of production, especially labor. On the extensive margin, the entry of new firms into the manufacturing sector would be associated with new demand for labor. Some studies show that this variable has positive impact on industrialization which is measured by manufacturing employment or value-added (Gui-Diby & Renard, 2015; Kang & Lee, 2011; Kaya, 2010; Rowthorn & Ramaswamy, 1999).

- **Foreign direct investment (t-1)**: Inward FDI, as a source of capital accumulation, can contribute to both job creation or destruction in manufacturing firms. The entry of multinationals into an economy affects job generation in two main ways. First, their settlement and/or expansion is done through a demand for factors of production such as labor. Second, they lead to positive spillovers to domestic firms through technology transfer and the demand for domestic intermediate goods (Markusen & Venables, 1999; Rodriguez-Clare, 1996; Kang & Lee, 2011; Fosfuri et al., 2001). For job destruction-effect, it is worth noting that, in the specific case of SSA, a significant share of FDI is often directed to the natural resources sector at the expense of the manufacturing sector (Asiedu, 2006). This Dutch disease phenomenon could adversely impact industrialization in Africa (Gui-Diby & Renard, 2015) and thus negatively affect manufacturing employment. In order to take into account the above-mentioned-effects, FDI inflows as a percentage of GDP are considered in the empirical models.

- **Trade openness (t-1)**: Although I control for the effect of firms' connection to export and import markets individually, outward orientation at the country level plays an important role in employment growth and in the hiring policy of manufacturing firms. In some developed and developing countries, employment growth is negatively impacted by manufacturing firms' exposure to imports of finished goods (Balsvik et al., 2015; Bräutigam & Tang, 2014; Malgouyres, 2014; David et al., 2013; Gebre-Egziabher, 2009; Redi, 2009; Gabriel & Ahiuma-Young,2008; Morris & Einhorn, 2008). The competitive pressure from imports would encourage firms to hire temporary workers at the expense of permanent workers (Saha et al., 2013). Trade openness is measured by the de facto KOF trade globalization index. This indicator is constructed as a weighted average of trade in goods, trade in services and trading partner diversity.

2.4.2 Data description

This sub-section presents some statistics at the industry, country and firm level. Concerning industries, I consider those listed in the database according to the International Standard Industrial Classification (ISIC revision 3.1). The overall sample of SSA firms includes 23,429 enterprises, with 12,890 manufacturing firms and 10,539 non-manufacturing firms (Table 2.2). Companies in wholesale and retail industry represent 61.97% of non-manufacturing firms and 27.88% of the total sample. Hence, wholesale corresponds to the most represented industry in the overall sample. However, in this paper, I study 23 manufacturing industries. The top 3 industries with more than half of manufacturing firms sample are: food products and beverages industry (26.91%); wearing apparel (13.24%); fabricated metal products except machinery and equipment (8.93%). The food industry, accounting for 26.93% of manufacturing firms and for 14.42% of the whole sample is the most represented industry in the manufacturing sample and the second most represented industry in the total sample. Also, capital-intensive and technology-intensive industries such as: office, accounting and computing machinery (0.02%); medical, precision and optical instruments, watches and clocks (0.15%); radio, television and communication equipment and apparatus (0.19%); recycling (0.19%) are less represented. In addition, Nigerian and Kenyan firms are the most represented in the manufacturing sample, accounting for 18.42% and 9.81%, respectively (Table 2.3). Taken together, firms operating in these two countries cover 28.23% of the manufacturing sample.

Table 2.4 displays the statistics at the aggregate level. For employment variables, the average number of permanent full-time workers in a manufacturing company is 70.94 employees. They are made up of 54.49 production workers and 17.50 non-production workers. As a result, more than 76.81% of permanent full-time workers are concentrated in the production unit. On average, the production team is composed of 21.30 unskilled employees and 30.31 skilled workers. Although SSA countries are highly endowed with unskilled labor relative to other regions of the world, its manufacturing firms, on average, have more skilled workers than unskilled employees. Temporary workers are on average 3.6 times less numerous than permanent full-time workers. The average annual production losses due to power outages is 13.37% of total sales for manufacturing firms. In the manufacturing sample, firms appear to be owned more by domestic private agents than by foreigners and the state. Indeed, the average share of capital held by nationals is 82.74% of the overall capital, while those held by foreigners and the state represent 11.81% and 0.84%, respectively. Small firms account for more than half (53%) of the study sample, followed by medium (32%) and large (16%) firms. In addition, the survey data allows for comparison of barriers related to electricity and transport infrastructure as well as those associated to labor market regulation. For electricity obstacles, 53%[9] of firms report that barriers to electricity are critical to their business. However, this share is 21% for transport obstacles and 9% for labor market regulation obstacles. In summary, electricity constraints seem to be more

[9]This statistic is the addition of the number of firms that report that electricity is a major (28%) and severe (25%) obstacle to their business activity.

crucial for manufacturing firms. On average, manufacturing firms export 9.81% of their production and import 29.14% of their inputs. In the 33 SSA countries surveyed, the average annual growth rate of power losses during the transmission is 17.67%. In addition, the growth rates of GDP and GDP per capita are 5.96% and 3.38%, respectively. Finally, SSA countries have a relatively high trade openness indicator (44%) with an inward FDI share of 3% of GDP.

2.5 Empirical strategy

This paper aims to study the effects of production losses due to power outages on employment in manufacturing firms that operate in SSA. This relationship is described by equation 2.1.

$$Employment_{fict} = \alpha + \beta Production\_Losses_{fict} + \mu F_{fict} + \gamma X_{ct-1} + \delta_c + \theta i + \epsilon_{fict} \quad (2.1)$$

$Employment_{fict}$ (log) represents the variable to be explained for firm f in country c at time t. It corresponds to either total employment, production employment and non-production employment, or unskilled workers, skilled workers and temporary workers. $Production\_Losses_{fict}$ (log) is the variable of interest namely the share of production losses due to power outages in total sales of firm f in country c at time t. F_{fict} and X_{ct-1} are firm and macroeconomic variables used as control, respectively.[10] δ_c and δ_i refer to country and industry fixed-effects, respectively while ϵ_{fict} is an idiosyncratic error term. Thus, the ordinary least squares (OLS) approach is applied on equation 2.1. However, a key weakness of this estimation method is its inability to correct for the endogeneity bias that the variable of interest may be subject to. Defined as correlation between the error term and the dependent variable, endogeneity emerges for two main reasons. First, the variable of interest is reported by the manager of each firm. This self-reporting could be subject to an over-estimation or under-estimation bias. The magnitude of the previous bias

[10] The macroeconomic variables are lagged by one year to avoid potential reverse causality bias.

will depend on firms' characteristics such as their size and the type of industry in which they operate. Hence, there might be a reverse causality bias due to correlation between firms' characteristics and their responses. Second, the omission of a relevant explanatory variable in the explanation of firms' employment is source of endogeneity. Indeed, the omitted variable will be in the error term, which will be correlated with the variable of interest.

To address the above issues, I apply the instrumental variables approach with country and industry fixed-effects (IVFE). The challenge is to find an instrument that can be correlated to the suspected endogenous variable without affecting outcomes through another channel. In a first step, this instrument and the set of control variables will be the regressors of production losses due to power outages. This step serves to eliminate any endogeneity bias from production losses. Once corrected for endogeneity from the first stage, the fitted values of production losses will be used as the variable of interest in the second step in which the employment variables will be the outcomes. I use as instrument the annual growth rate of power losses in the total number of GWh produced. These losses occur during the transmission and transportation of electricity from supply sources to distribution points, including distribution to consumers. This instrument should positively and directly affect the production losses due to power outages. Indeed, if the number of GWh produced at time t is reduced during the transmission, some consumers (manufacturing firms) will have either a low electricity voltage or no electricity. A low voltage will fail to run all the production machines simultaneously[11] or to run a particular machine to its full potential.[12] The absence of electricity will make the whole production machinery non-operational. Thus, the low voltage and the non operationalization of some machines will generate a gap between the production targeted by firms and the effective output. I therefore expect a positive relationship between electricity losses and production losses. This relationship is described by the following equation:

[11] If the company has several manufacturing machines.

[12] If the company has only one machine.

$$Production\_Losses_{fict} = \phi + \eta Electricity\_Losses_{ct} + \sigma F_{fict} + \zeta X_{ct-1} + \delta_c + \theta i + \nu_{fict} \quad \textbf{(2.2)}$$

Where $Electricity\_Losses_{ct}$ is the annual growth of electricity losses, the instrument. As expected, Figure 2.14 shows a positive and statistically significant correlation between electricity losses and production losses. Consequently, the occurrence of power losses during the transmission of electricity is positively correlated with production losses of manufacturing firms in SSA. The equation of the second step is:

$$Employment_{fict} = a + b\widehat{Production\_Losses}_{fict} + dF_{fct} + eX_{ct-1} + \delta_c + \theta i + \Gamma_{ict} \quad \textbf{(2.3)}$$

Where $\widehat{Production\_Losses}_{fict}$ is the fitted values of production losses from the first stage. Figure 2.15 shows the correlation between employment variables and production losses. There is a negative correlation with statistical significance between total employment, production employment, unskilled and skilled employment (Figure 2.15). Hence, Figure 2.15 confirms (in terms of correlation) the relationship discussed in the theoretical framework between employment and production losses. Moreover, the IVFE method is associated with a number of tests that check the statistical validity of the instrument, notably under-identification and weak identification tests. The under-identification test (Kleibergen-Paap rk LM statistic) is a LM test that allows to assess whether the instrument is correlated to the endogenous variable or not. This test is applied with a null hypothesis of under-identification regarding the instrumentation model. Hence, the instrument will be valid and therefore relevant, if the test reject the null hypothesis. The weak identification test (Kleibergen-Paap rk Wald F statistic) allows to see how weakly the instrument is correlated with the endogenous variable. The endogenous variable can poorly explain outcomes if the instrument is weakly correlated to it. The instrument will be valid in terms of weak identification if the Kleibergen-Paap rk Wald F statistic is greater than the critical values of Stock-Yogo.

2.6 Results

The main results are reported in Table 2.5 and Table 2.6. To examine the extent to which instrumentation acts, the results of the OLS method and those of the IVFE method are presented in each Table. In Table 2.5, three models are estimated from the OLS and IVFE methods. The first one is a linear regression in which the number of total workers is the dependent variable, and then it is decomposed into production and non-production workers. The first three columns of Table 2.5 provide the results of the OLS method and the last six columns contain the results of the IVFE method. From column 1 to column 3, the production losses due to power outages negatively affect total workers, non-production workers and production workers. In more detail, a 1 percentage point increase in production losses by sales reduces total employment (log), non-production employment (log) and production employment (log) by 0.02 percentage points. This effect accounts for 1.6% of the standard deviation of total employment (standard deviation=1.24), 1.5% of the standard deviation of non-production employment (standard deviation=1.29), and 1.6% of the standard deviation of production employment (standard deviation=1.24).[13] Hence, the shares of the effects of production losses in the overall dispersion of the above employment variables show a relatively moderate impact of production losses according to the OLS method.

The first step estimates of columns 4-6 show that the annual growth of electricity losses, as instrument, is relevant. Indeed, the null hypothesis of the under-identification tests are rejected with p-values of 1%. Also, the hypothesis of the weak identification tests are rejected because the Kleibergen-Paap rk Wald F statistics (44.18; 42.65; 44.11) are greater than the critical values of Stock-Yogo (16.38; 8.96; 6.66; 5.53). Besides the positive correlation outlined in Figure 2.14, the first stage estimates show that electricity losses positively and significantly affect production losses due to power outages. The results of the second step estimates are reported in columns 4-6. The production losses due to power outages negatively impact total employees (column 4), positively affect non-production employees (col-

[13] The standard deviations mentioned are those of the variables in logarithm.

umn 5), and negatively influence production employees (column 6). A 1 percentage point increase in production losses to sales reduces total employees by 0.12 percentage points, increases non-production workers by 0.72 percentage points and reduces production employees by 0.26 percentage points. The share of production losses' effects in the standard deviations of the employment variables are: 9.67% for total jobs, 55.81% for non-production workers and 20.97% for production employees. Compared to the OLS method, the IVFE method strongly increases the share of the effect of production losses in the total dispersion of employment variables. For example, the effect of increased production losses accounts for 20.97% in the decline of production employment in manufacturing firms, which is a relatively large proportion. However, as discussed in the theoretical framework, the effect of production losses on non-production employment is positive. Therefore, the negative effect of production losses on total employment is fully explained by the reduction in production employees. This result is plausible because production employees work on machines that are dependent on electricity, making them more vulnerable to production losses due to power outages. The positive effect on non-production workers can be explained by the substitutability between labor and particular tools in the non-production unit.

Since the decline in employment due to production losses passes through the production employees, they are classified into two groups: unskilled and skilled workers. Table 2.6 illustrates the effects of production losses on these two categories of workers as well as on temporary workers. Applying the OLS method in the first time, it appears that production losses negatively affect unskilled and temporary workers while the impact on skilled employees is not statistically significant although negative (columns 1-3). A 1 percentage point increase in production losses to sales reduces the number of unskilled and temporary workers by 0.06 and 0.07 percentage points, respectively. To address endogeneity, I apply the IVFE method. As in Table 2.5, electricity losses are relevant as instrument. The null hypothesis of under-identification are rejected by p-values of 1%. The null hypothesis of weak identification are also rejected because, the Kleibergen-Paap rk Wald F statistics of 41.26, 43.78 and 38.36 are greater than the critical values of Stock-Yogo (the first stage estimates of columns 4-6). Compared to the OLS method, the instrumentation increases the effects of production losses on unskilled and temporary workers while making the one on skilled workers statistically significant. More precisely, a 1 percentage point increase in production losses reduces the number of unskilled, skilled, and temporary workers by 0.36 (column 4), 0.22 (column 5), and 0.53 (column 6) percentage points, respectively. Hence, the reduction in production workers due to production losses observed in Table 2.5 is driven by unskilled and skilled workers, with a larger effect on unskilled employees. Furthermore, with a reduction of 0.53 percentage points, temporary workers are much more vulnerable to production losses. The coefficients obtained in Table 2.6 are very substantial. Indeed, the share of the impact of production losses in the standard deviation of employment variables is 24.16% for unskilled workers, 18.03% for skilled workers and 35.33% for temporary workers. Note that the standard deviations of the log of unskilled, skilled and temporary workers are 1.49, 1.22 and 1.50, respectively. The vulnerability of temporary workers is explained by the fact that, in the context of a negative shock like production losses due to power outages, it is easier for companies to dismiss workers with short-term contracts. Indeed, they are often not represented by trade unions and are not covered by labor laws applicable to workers employed on long-term contracts. The vulnerability of unskilled workers is explained by the fact that, in a context of falling production due to productivity declines, and to not further reduce total factor productivity, firms would choose to layoff the least skilled employees more than skilled employees.

2.7 Heterogeneity tests

As mentioned in the theoretical framework, self-generation has opposite effects on employment. On the one hand, the use of generators would prevent firms from production losses due to power outages, which should protect workers from layoffs. Thus, in firms where a significant share of electricity consumption comes from generators, one would expect a small impact of production losses on employment. On the other hand, the transaction costs of self-generation could expose workers to layoffs in firms with a large share of electricity consumption from generators. To understand which of the two effects prevails, I divide the sample into two groups: self-generation firms and non-self-generation firms. Firms in which more than 50% of the electricity consumed comes from generators are treated as self-generation firms. In contrast, firms in which less than 50% of the electricity consumed comes from generators are considered as non-self-generation firms. Table 2.7 and Table 2.8 report the results of the OLS and IVFE estimates in the two sub-samples.

Panel A of Table 2.7 concerns the sample of self-generation firms while Panel B focuses on the non-self-generation firms sample. First, the OLS estimates in the two sub-samples show that there is no significant difference between the coefficients of production losses (column 1 & 3). Second, the instrumentation shows that production losses act more on workers in non-self-generation firms compared to self-generation firms. Indeed, a 1 percentage point increase in production losses reduces the total number of workers by 0.20 percentage points in non-self-generation firms while this effect is not significant in self-generation firms (column 4). In addition, production losses increase the number of non-production workers by 0.65 percentage points and reduce the number of production workers by 0.25 percentage points in self-generation firms (column 5 & 6). These effects are 0.79 and 0.35 percentage points in non-self-generation firms for non-production and production employees, respectively (column 5 & 6). It is important to note that the instrument remains valid even with the change of sample.

Panel A and B of Table 2.8 report the OLS and IVFE estimates for unskilled, skilled, and temporary workers in the two sub-samples. The OLS method indicates that production losses affect unskilled and temporary workers more in self-generation firms than in non-self-generation firms (column 1 & 3). This finding is confirmed by the IVFE estimates. Indeed, in self-generation firms, a 1 percentage point increase in production losses reduces the number of unskilled, skilled, and temporary workers by 0.44, 0.21, and 0.63 percentage points, respectively (columns 4-6). However, these effects are not statistically significant in the sample of non-self-generation firms. The above results, which are much more disaggregated than those in Table 2.7, establishes that self-generation, at a certain threshold (more than 50% of electricity consumed), has a deleterious effect on workers.

2.8 Robustness check

The purpose of the present robustness check is to examine the extent to which the above results are confirmed when the endogeneity bias is treated through another estimation method. To avoid the omitted variables problem, I apply the multi-level model approach as method of estimation. It allows for the introduction of country and industry fixed and random effects simultaneously. Thus, country and industry fixed effects are introduced as well as country and industry random effects. However, the LR test is performed to understand if the model with random-effects is better than the one without random-effects. This test compares the model with fixed and random effects (full model) to the one with fixed effects only. It is based on a null hypothesis considering the parameters of the random effects as equal to zero. Therefore, the addition of random effects to fixed effects will depend on the result of the LR test for each model. To avoid the endogeneity bias due to reverse causality, I use the local measure of each explanatory firm variable. This local measure is determined as the average of the individual responses of all firms having the same size, in the same country, city and industry. With regard to variable j, I consider the average of the response of firm i with the responses of all other companies in the same country, city, industry and with the same size like firm i. The country-city-size-industry dimension becomes the basic unit to determine the local variables of firms' responses. Since firms in the same country, city, industries and with the same size are likely to share the same characteristics, the average of variable j on the previous dimension will not be affected by the individual characteristics of firms but by the local characteristics related to the country, city and industry in which firms operate. In addition, companies in the same country, city, and industry are likely to be similarly affected by an economic problem. Thus, the local measure of variable j is comparable to the individual response of firm i about variable j with the difference that the reverse causality is minimized. Some studies have used this type of local measure to avoid reverse causality (Chauvet & Jacolin, 2017; Harrison et al., 2014). The model used in the estimates is as follows:

$$Employment_{f,i,c,l,t} = \rho Production\_Losses_{f,i,c,l,t} + \tau E_{f,i,c,l,t} + F_{c,t} + \delta_c + \theta i + \delta_{c,t} + \theta_{i,t} + \omega_{f,i,c,l,t} \quad (2.4)$$

$Employment_{f,i,c,l,t}$: employment of firm f in industry i, country c, local-dimension l at year t.

$Production\_loss_{f,i,c,l,t}$: local production losses of firm f in country c, industry i, local-dimension l and year t.

$E_{f,i,c,l,t}$: local control variables of firm f in country c, industry i, local-dimension l and year t.

$F_{c,t}$: macroeconomic variables in country c at year t.

δ_c : country fixed effects.

θi : industry fixed effects.

$\delta_{c,t}$: country random effects.

$\theta_{i,t}$: industry random effects.

$\omega_{f,i,c,l,t}$: error term in the model.

Table 2.9 presents the results from the multi-level model regressions method. In each model, the country and industry fixed and random effects are introduced simultaneously since the full model is more relevant than the model with the fixed effects only. Indeed, the LR tests reveal that the null hypothesis of the random effects parameters are rejected by the p-values. The use of local level variables confirms the negative effects of production losses on total employees, production employees, unskilled and skilled workers. For instance, a 1 percentage point increase in local production losses due to power outages reduces the number of total workers, production employees, unskilled and skilled workers by 0.06, 0.07 and 0.03 percentage points (column 1, 3, 4 & 5). Although the sign and the statistical significance are both confirmed, the magnitude of the effects of local production losses is very small compared to that in the IVFE method. In addition, the effect on non-production workers becomes negative while the impact on temporary workers is no longer statistically significant (column 2 & 6). These differences can be explained mainly by the transition to the local level.

In terms of economic policy implications, the above results are recommended conditional to the control variables. However, there may be some complementarity or substitutability between the variable of interest and the control variables. To investigate this point, I repeat the estimates in Table 2.9 for unskilled and skilled workers by introducing the control variables one by one. For unskilled and skilled workers, the stepwise introduction of the control variables does not change the sign and the statistical significance of the local production losses' impact (Table 2.10 & Table 2.11). However, in Table 2.10, introducing the share of capital owned by nationals and the number of employees three years ago reduces the effect of local production losses by 0.03 and 0.05 percentage points, respectively (column 3 & 5). In Table 2.11, introducing the number of employees three years ago also reduces the effect of local production losses by 0.07 percentage points (column 5). This evidence suggests that firms that hired heavily three years ago would have difficulty laying off workers in the context of a negative shock to output.

2.9 Concluding remarks

The transition of an economy from the traditional to the modern sector seems to be the unavoidable path to improving living standards and fighting poverty in developing countries. This process, known as structural transformation, allows labor to move from the agriculture to the manufacturing sector. This trend leads to an increase in total factor of productivity and wages because labor moves from the low to the high productivity sector. Despite the importance of this process in the development of sub-Saharan African economies, the manufacturing sector in this region struggles to absorb a large share of unskilled labor. The issue of labor movement towards manufacturing is critical in sub-Saharan Africa for two main reasons. First, its young population would double by 2050 to reach 2 billion people, i.e., one-fifth of the world population. Second, the African labor market would reach 500 million people by 2025 and would welcome 29 million people each year by 2030. Thus, the challenge for policymakers in the future is to make the sub-Saharan manufacturing sector capable of absorbing this high demographic growth. One way to achieve this goal is, therefore, to reduce or completely remove the constraints on the business of sub-Saharan manufacturing firms. More specifically, constraints related to the electricity infrastructure. Indeed, the power service enter the production process as input, so its poor quality may lead to production losses that could negatively affect the willingness of firms to retain and/or recruit unskilled workers.

From the above, the purpose of this paper is to understand the constraints affecting the willingness of modern sector like manufacturing to retain or welcome workers. Using the instrumental variables approach with country and industry fixed effects, I find that production losses due to power outages negatively affect overall employees, positively impact non-production workers and negatively affect production employees. Hence, the negative effect of production losses on total workers occurs only through production employees. Consequently, the latter category of workers is classified into two groups: skilled and unskilled employees. The results reveal that temporary and unskilled workers are more vulnerable to production losses due to power outages compared to skilled employees. Heterogeneity tests in relation to self-generation show that the adoption of a generator has a deleterious effect on temporary, unskilled and skilled workers. Once again, the effect is marked on temporary and unskilled workers. The previous findings are supported in part by the use of multi-level regressions and local measures of firm responses.

The policy implications of this paper are clear. Until at least 2050, improving the quality of electricity service as well as access to electricity for businesses have to be top priorities for sub-Saharan African governments. The required measures can be implemented through two types of policies. First, African states must mobilize funds to invest massively in the energy sector. The aim is to increase the production of electricity and to improve the quality of its service (limit or completely eliminate power outages). Some African countries have an impressive potential for hydroelectricity which, if exploited, could power several cities in several countries simultaneously. In this context, regional and sub-regional cooperation should be strengthened around large hydro-power dam construction projects. Moreover, raising funds would be easier by means of regional cooperation than through the individual initiative of a single country. In addition, other countries have some comparative advantage in solar energy production. The construction of solar power plants capable of supporting the manufacturing activity is also an alternative. These power plants, intended only for firms, would disconnect the source of energy consumption of firms from those of households, freeing up some GWh of the usual grid for households. Second, as a short-term measure, governments that are able to do so should subsidize, to the best of their ability, the use of generators by manufacturing firms. This short-term measure could reduce the huge transaction costs that self-generating firms face.

Figure 2.1: Employment by sector in sub-Saharan Africa in 2019 (%)

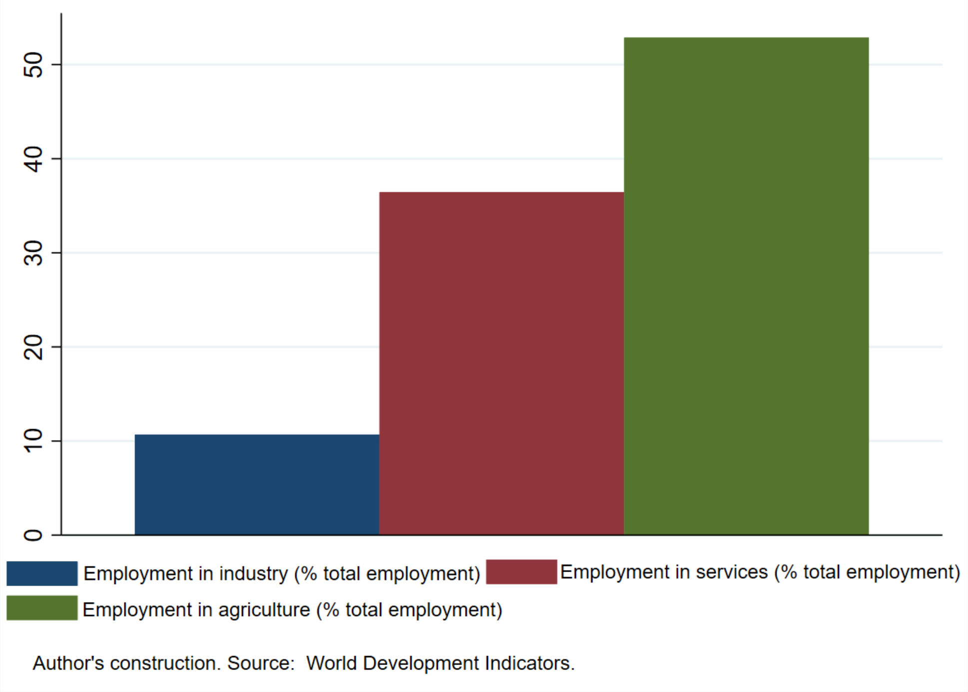


Figure 2.2: Employment by sector and gender in sub-Saharan Africa in 2019 (%)

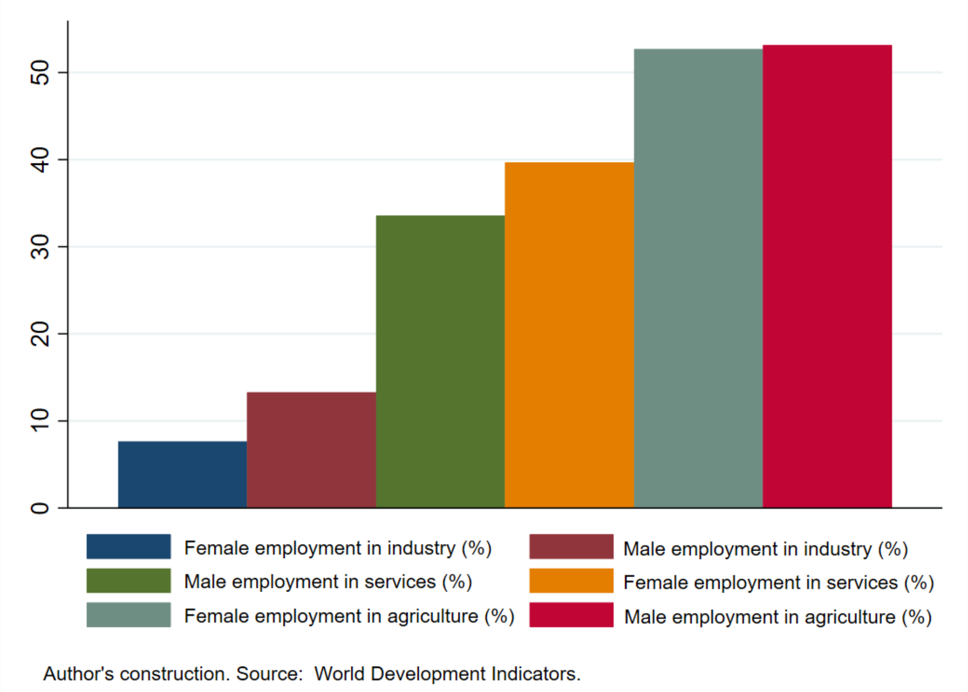


Figure 2.3: Access to electricity (% of population) by World Bank regions classification

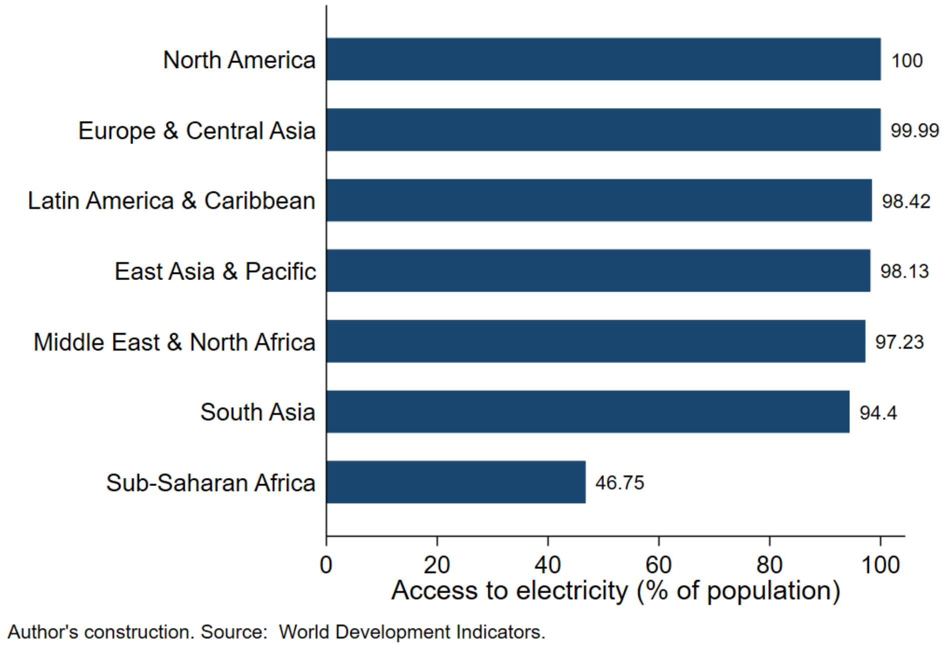


Figure 2.4: Access to electricity (% of urban population) by World Bank regions classification

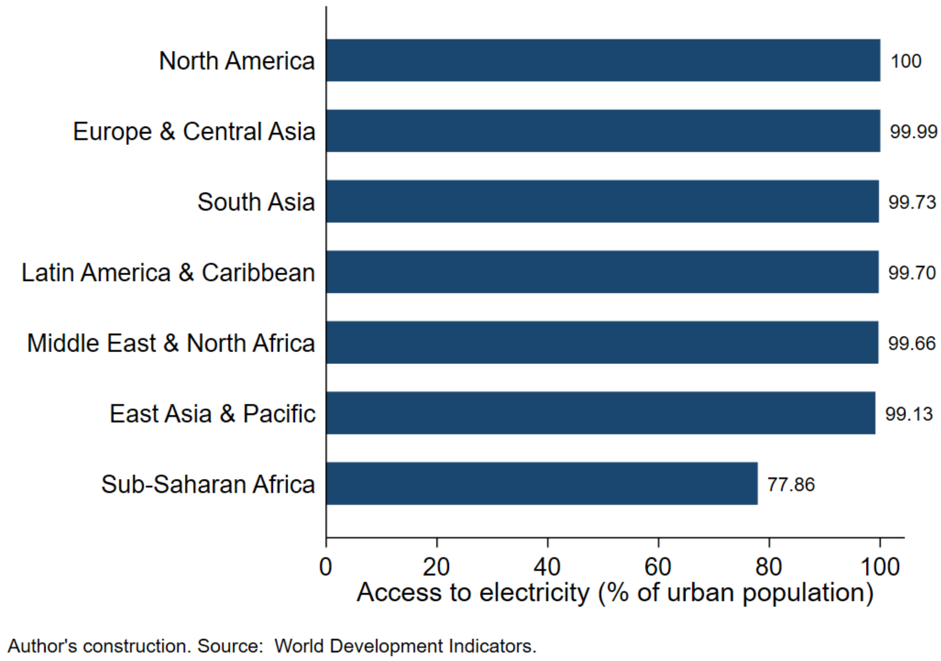


Figure 2.5: Access to electricity (% of rural population) by World Bank regions classification

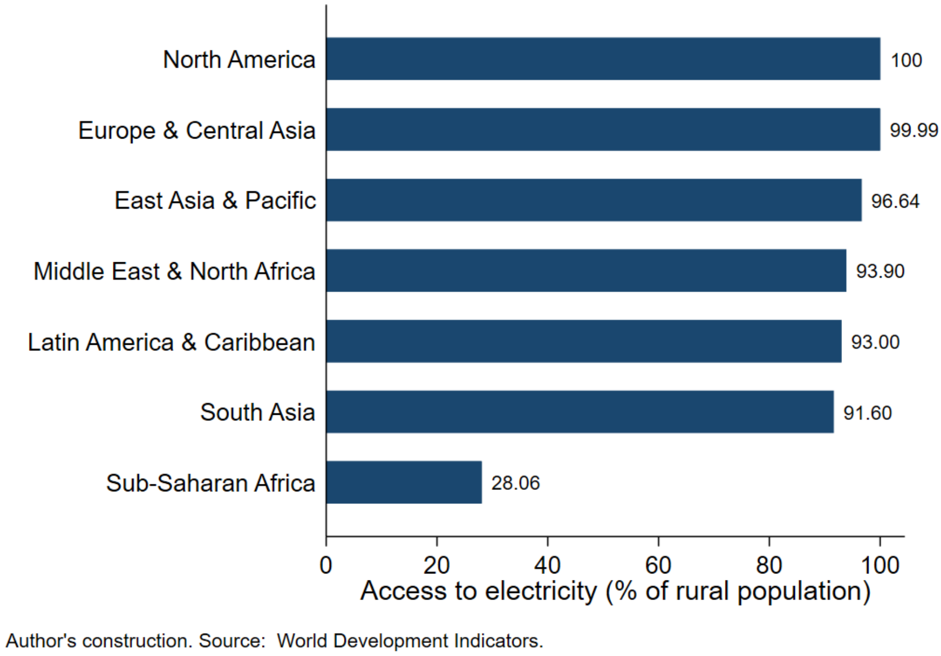


Figure 2.6: Biggest obstacle affecting the operations of manufacturing firms in sub-Saharan Africa

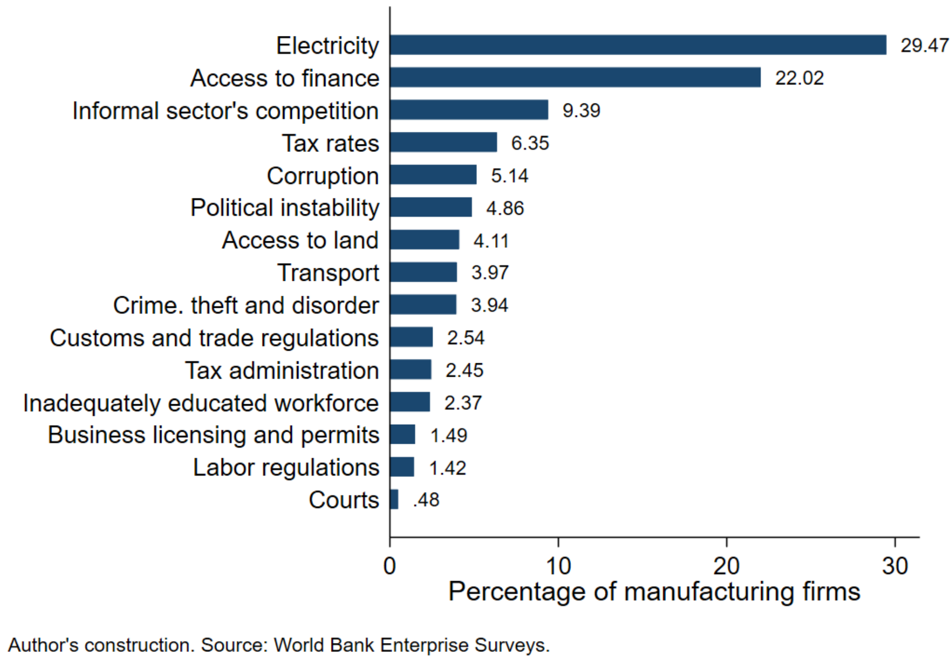
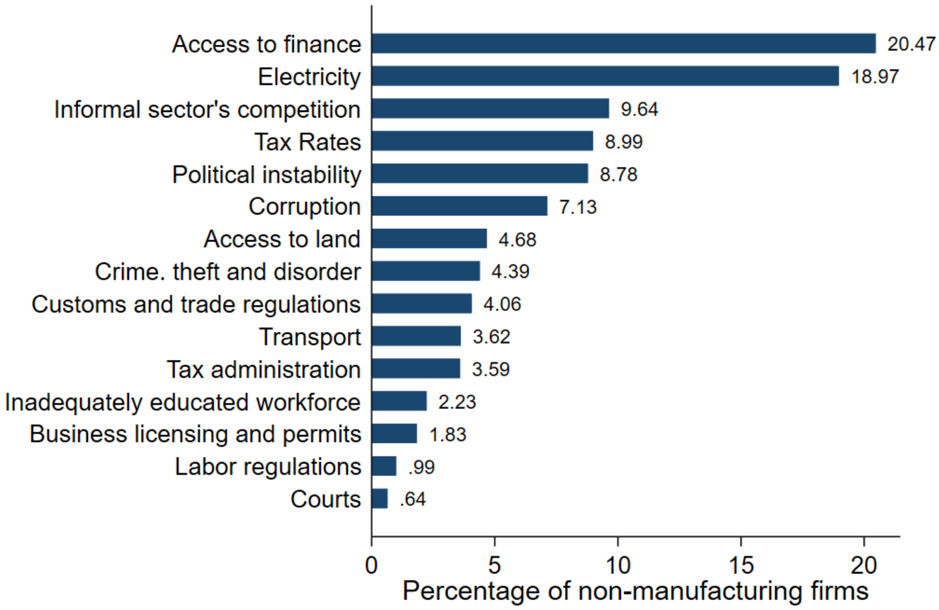
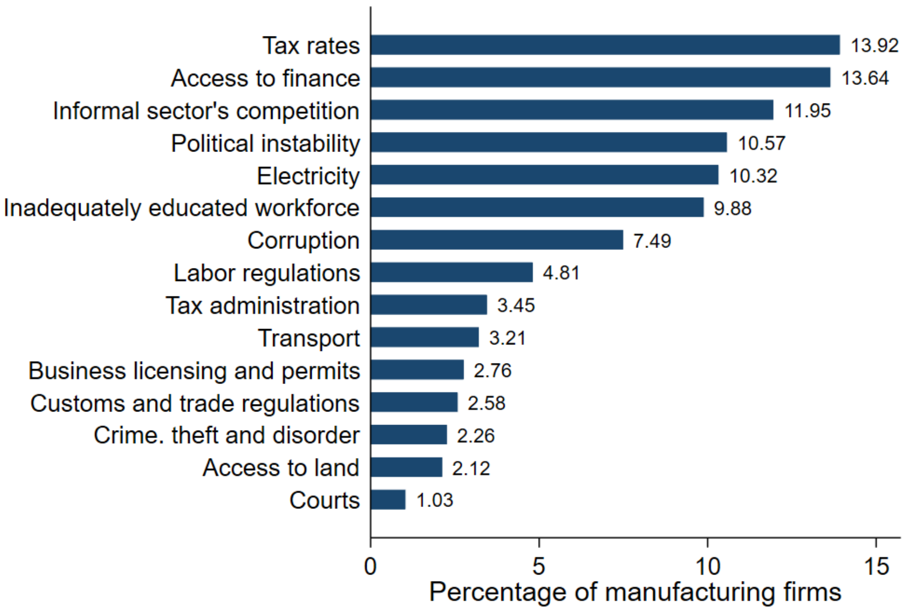


Figure 2.7: Biggest obstacle affecting the operations of non-manufacturing firms in sub-Saharan Africa



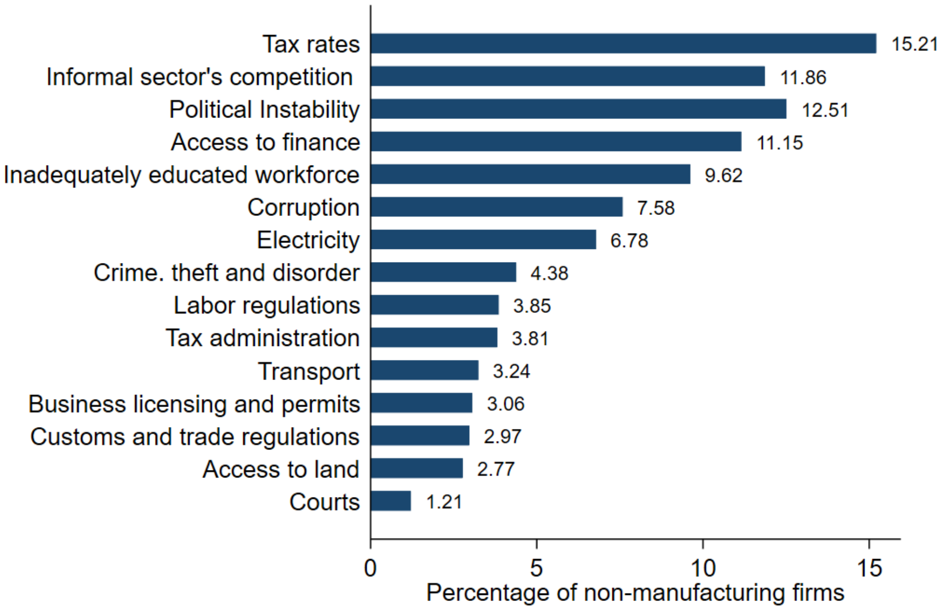
Author's construction. Source: World Bank Enterprise surveys.

Figure 2.8: Biggest obstacle affecting the operations of manufacturing firms in other developing countries

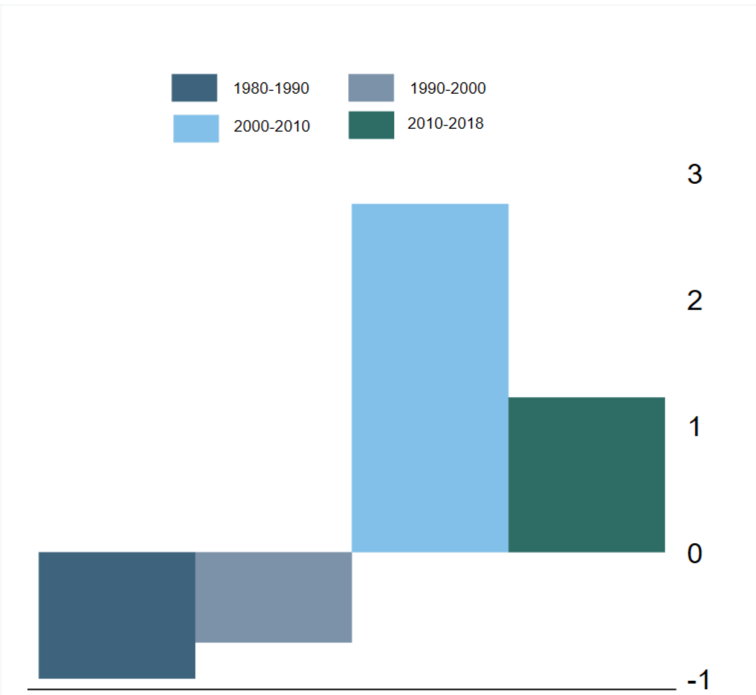


Author's construction. Source: World Bank Enterprise Surveys.

Figure 2.9: Biggest obstacle affecting the operations of non-manufacturing firms in other developing



Author's construction. Source: World Bank Enterprise Surveys.



Author's construction. Source: United Nations Statistics Division.

Figure 2.10: Average per-capita GDP growth by sub-periods

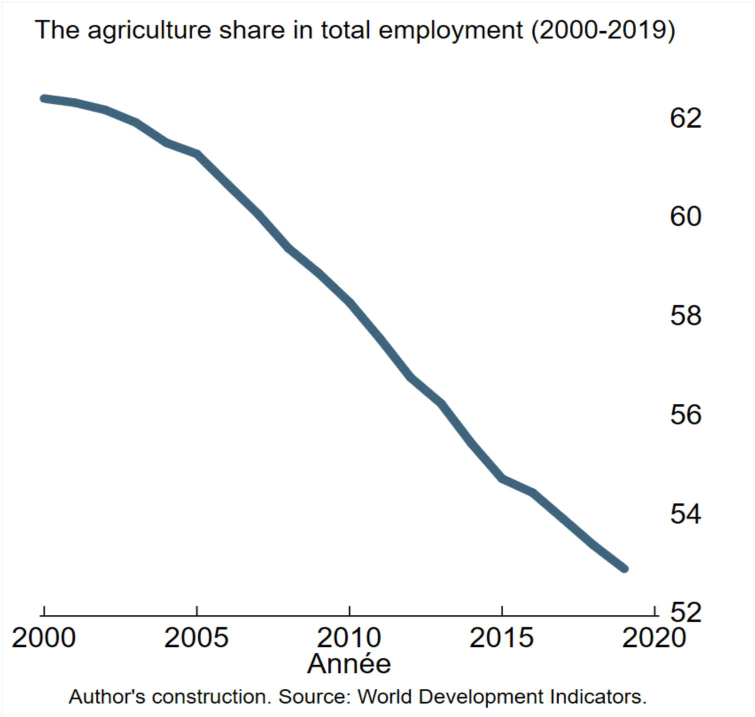


Figure 2.11: The agriculture share in total employment

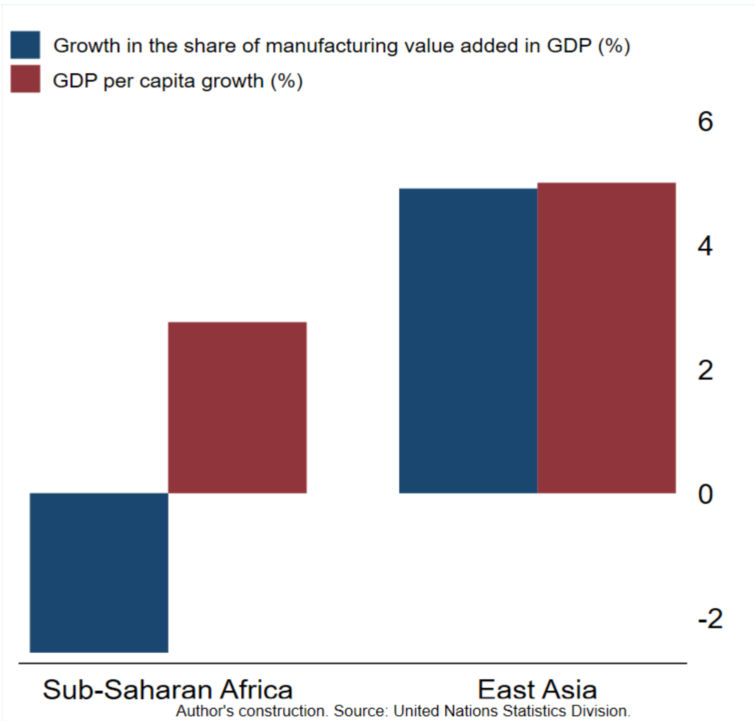
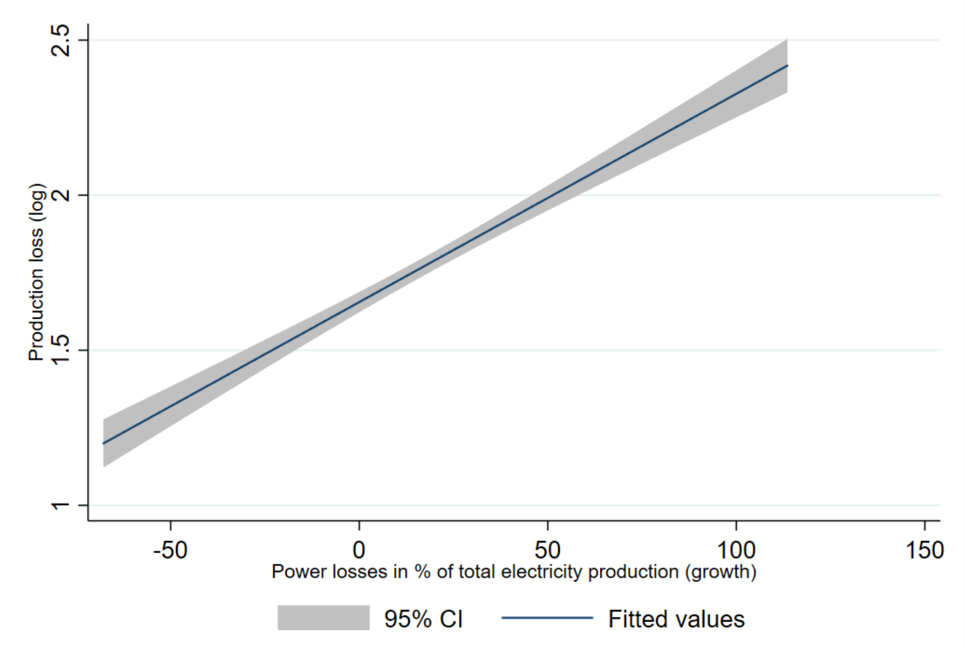
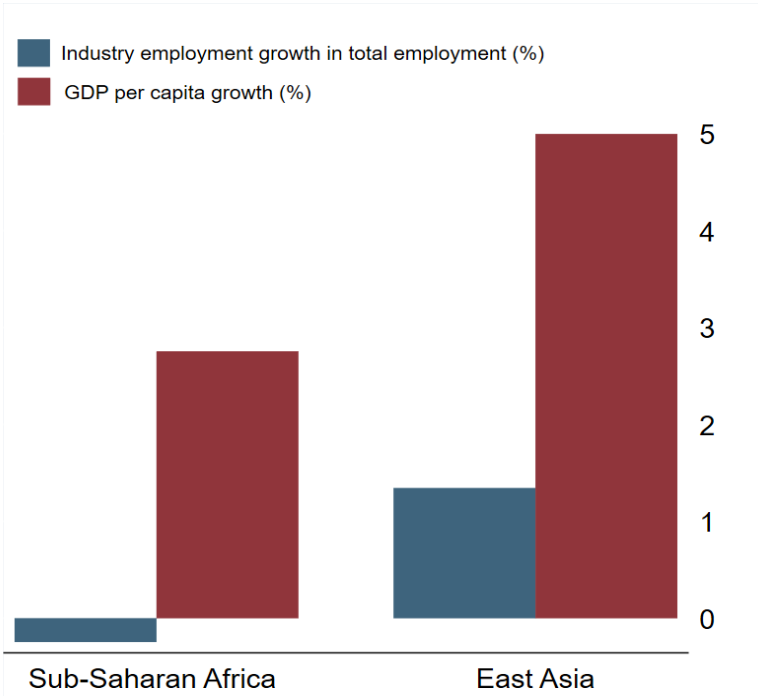


Figure 2.12: The growth of the manufacturing's share in GDP and per-Capita GDP growth

Figure 2.14: Correlation between electricity losses (% total electricity) and production loss due to power outages in sub-Saharan African manufacturing firms



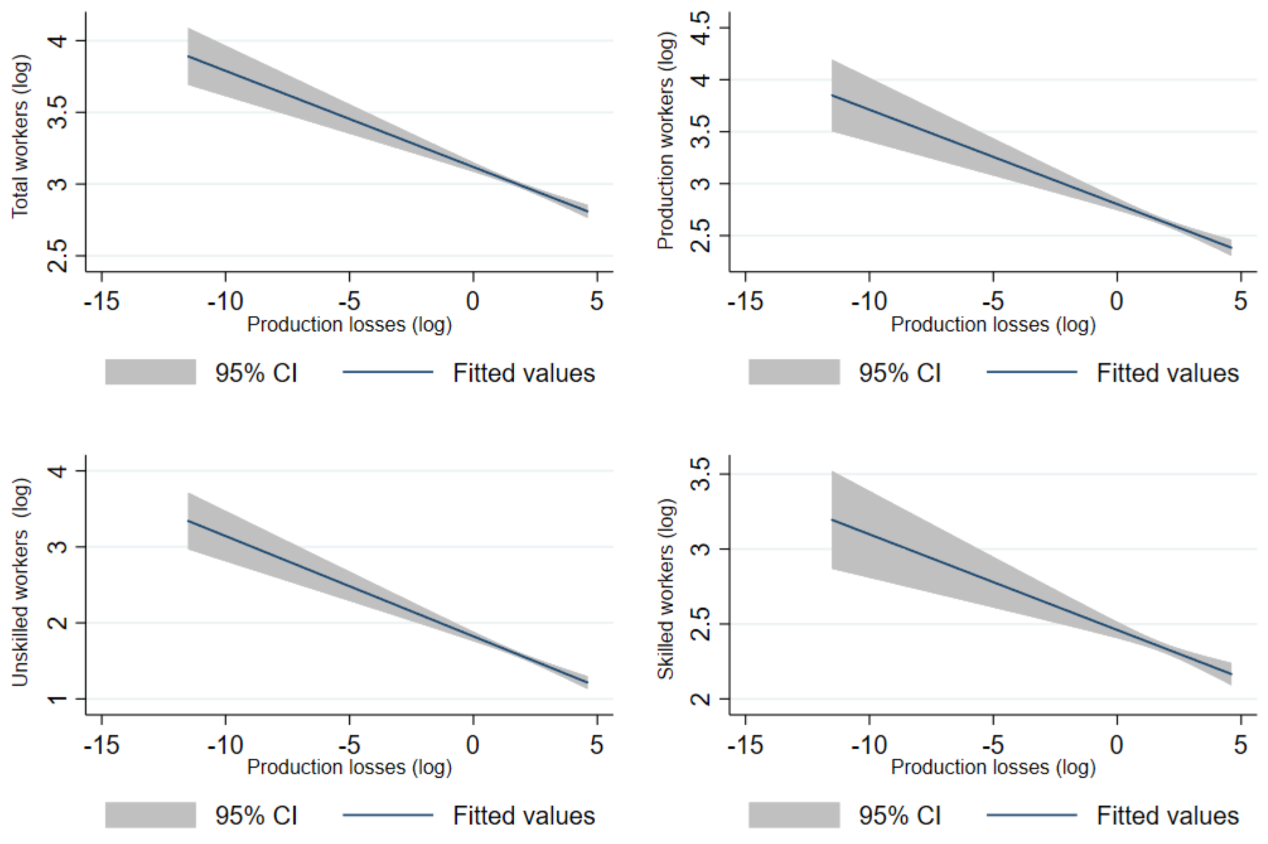
Author's construction. Source: World Bank Enterprise Surveys.



Author's construction. Source: United Nations Statistics Division.

Figure 2.13: The growth of industrial employment's share in total employment and per-capita GDP growth

Figure 2.15: Correlation between employment variables and production loss due to power outages in sub-Saharan African manufacturing firms



Author's construction. Source: World Bank Enterprise Surveys.

Table 2.2: Number of firms and the share of each industry in the total sample of its sector

Industries	ISIC Code	Number of firms	Percent
Manufacturing sector		12890	100.00
Manufacture of food products and beverages	15	3469	26.91
Manufacture of tobacco products	16	28	0.22
Manufacture of textiles	17	472	3.66
Manufacture of wearing apparel	18	1706	13.24
Tanning and dressing of leather	19	257	1.99
Manufacture of wood and of products of wood	20	553	4.29
Manufacture of paper and paper products	21	154	1.19
Publishing, printing and reproduction of recorded media	22	904	7.01
Manufacture of coke, refined petroleum products	23	53	0.41
Manufacture of chemicals and chemical products	24	705	5.47
Manufacture of rubber and plastics products	25	455	3.53
Manufacture of basic metals	26	684	5.31
Manufacture of other non-metallic mineral products	27	275	2.13
Manufacture of fabricated metal products	28	1151	8.93
Manufacture of machinery and equipment n.e.c.	29	271	2.10
Manufacture of office, accounting and computing machinery	30	3	0.02
Manufacture of electrical machinery and apparatus n.e.c.	31	157	1.22
Manufacture of radio, television and communication equipment	32	24	0.19
Manufacture of medical, precision and optical instruments	33	19	0.15
Manufacture of motor vehicles, trailers and semi-trailers	34	82	0.64
Manufacture of other transport equipment	35	34	0.26
Manufacture of furniture; manufacturing n.e.c	36	1410	10.94
Recycling	37	24	0.19
Non-manufacturing sector		10539	100.00
Other Industries	4	3	0.03
Mining and quarrying	10	2	0.02
Collection, purification and distribution of water	40	2	0.02
Construction	45	1004	9.53
Wholesale and retail trade	50	6531	61.97
Hotels and restaurants	55	1678	15.92
Transport, storage and communications	60	994	9.43
Financial intermediation	65	2	0.02
Real estate, renting and business activities	70	319	3.03
Other community, social and personal service activities	90	4	0.04

Table 2.3: Total firms, manufacturing firms and non-manufacturing firms by country and year

Country	Year	Total	Manufacturing	Non-manufacturing
Angola	2006	425	213	212
Angola	2010	360	78	282
Burundi	2006	270	102	168
Burundi	2014	157	60	97
Botswana	2006	342	114	228
Botswana	2010	268	85	183
Burkina Faso	2009	394	95	299
Benin	2009	150	72	78
Benin	2016	150	70	80
Cameroon	2009	363	106	257
Cameroon	2016	361	102	259
Chad	2009	150	60	90
Chad	2018	153	74	79
Ethiopia	2011	644	321	323
Ethiopia	2015	848	383	465
Gabon	2009	179	.	179
Ghana	2007	494	292	202
Ghana	2013	720	377	343
Guinea	2006	223	135	88
Guinea	2016	150	27	123
Guinea-Bissau	2006	159	50	109
Kenya	2007	657	396	261
Kenya	2013	781	414	367
Kenya	2018	1,001	455	546
Lesotho	2009	151	.	151
Lesotho	2016	150	76	74
Liberia	2009	150	.	150
Liberia	2017	151	75	76
Madagascar	2009	445	204	241
Madagascar	2013	532	.	532
Malawi	2009	150	71	79
Malawi	2014	523	197	326
Mali	2007	490	301	189
Mali	2010	360	160	200
Mali	2016	185	99	86
Mauritania	2006	237	80	157
Mauritania	2014	150	52	98
Mauritius	2009	398	216	182
Mozambique	2007	479	341	138
Mozambique	2018	601	287	314
Namibia	2006	329	106	223
Namibia	2014	580	181	399
Nigeria	2007	1,891	948	943
Nigeria	2014	2,676	1,427	1,249
Rwanda	2006	212	59	153
Rwanda	2011	241	81	160
Rwanda	2019	360	120	240
Senegal	2007	506	259	247
Senegal	2014	601	249	352
Sierra Leone	2009	150	.	150
Sierra Leone	2017	152	77	75
South Africa	2007	937	680	257
South Africa	2020	937	680	257
Sudan	2014	662	82	580
Tanzania	2006	419	273	146
Tanzania	2013	813	440	373
Togo	2009	155	35	120
Togo	2016	150	45	105
Uganda	2006	563	307	256
Uganda	2013	762	378	384
Zambia	2007	484	304	180
Zambia	2013	720	364	356
Zambia	2019	601	180	421
Zimbabwe	2011	599	376	223
Zimbabwe	2016	600	289	311

Table 2.4: Descriptive statistics of the main variables

	Firms variables				
	Mean.	Std. Dev.	Min	Max	Observation
Full-time and permanent employees	70.94	264.00	0.00	8000.00	12780
Full-time and permanent production employees	54.49	221.41	0.00	7000.00	11538
Full-time and permanent non-production employees	17.50	83.97	0.00	4087.00	11462
Full-time and permanent unskilled production employees	21.30	131.16	0.00	5050.00	11174
Full-time and permanent skilled production employees	30.31	121.48	0.00	4250.00	9425
Full-time and temporary production employees	19.45	198.22	0.00	16115.00	12431
Production loss	13.37	15.51	0.00	100.00	6651
Domestic private	82.74	35.00	0.00	100.00	12617
Foreign private	11.81	29.70	0.00	100.00	12603
Government	0.85	6.80	0.00	100.00	12611
Employment(t-3)	67.18	258.68	0.00	9000.00	11540
Sales(t-3)	6.94e+09	1.67e+11	0.00	1.40e+13	9808
Size					
Small (<20)	53%	0.50	0	1	6770
Medium (20-99)	32%	0.47	0	1	4084
Large (>99)	16%	0.36	0	1	2036
Sales (t-3)	2.77e+08	7.16e+09	0.00	5.90e+11	9313
Electricity obstacles					
No obstacles	14%	0.35	0	1	1820
Minor obstacles	17%	0.37	0	1	2119
Moderate obstacles	17%	0.37	0	1	2136
Major obstacles	28%	0.45	0	1	3546
Very severe obstacles	25%	0.43	0	1	3220
Transport obstacles					
No obstacles	30%	0.46	0	1	3824
Minor obstacles	26%	0.44	0	1	3278
Moderate obstacles	21%	0.41	0	1	2680
Major obstacles	16%	0.37	0	1	2105
Very severe obstacles	7%	0.25	0	1	882
Labor market regulation obstacles					
No obstacles	48%	0.50	0	1	6144
Minor obstacles	28%	0.45	0	1	3541
Moderate obstacles	15%	0.36	0	1	1941
Major obstacles	7%	0.25	0	1	889
Very severe obstacles	2%	0.14	0	1	240
Exports	9.81	24.05	0.00	100.00	12579
Inputs imports	29.14	36.60	0.00	100.00	11799
	Macroeconomics variables				
Electricity losses (growth rate)	17.67	35.56	-67.82	113.53	8446
Growth (t-1)	5.96	3.54	-20.60	14.05	12890
GDP per capita growth (t-1)	3.38	3.53	-22.31	11.32	12890
Trade openness (t-1)	44.46	13.92	14.52	81.54	11724
FDI (t-1)	3.46	4.36	-3.72	26.21	12890
N	12890				

Table 2.5: Effect of production loss due to electricity shortages on full time and permanent workers, production and non-production workers

	Dependent variables : Total workers, non-production and production workers								
	Linear fixed-effects model			Instrumental variables for panel-data models					
	Total workers	Non-production workers	Production workers	Total workers		Non-production workers		Production workers	
	Model 1	Model 2	Model 3	First Stage	Model 4	First Stage	Model 5	First Stage	Model 6
Production loss	-0.02***	-0.02**	-0.02***		-0.12**		0.72***		-0.26***
	(0.01)	(0.01)	(0.01)		(0.06)		(0.15)		(0.08)
Domestic private	-0.00	-0.00**	0.00	-0.00	-0.00	-0.00*	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Foreign private	0.00	-0.00	0.00**	-0.00*	-0.00	-0.00**	0.00	-0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Government	0.00	0.01**	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Medium firms	1.22***	0.96***	1.18***	-0.14***	1.21***	-0.13**	1.07***	-0.14**	1.15***
	(0.02)	(0.03)	(0.02)	(0.05)	(0.02)	(0.05)	(0.06)	(0.05)	(0.03)
Large firms	2.50***	1.97***	2.46***	-0.33***	2.44***	-0.32***	2.20***	-0.32***	2.33***
	(0.04)	(0.05)	(0.05)	(0.08)	(0.06)	(0.08)	(0.10)	(0.08)	(0.08)
Employment(t-3)	0.00***	0.00***	0.00***	-0.00	0.00***	-0.00	0.00***	0.00	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Sales(t-3)	0.00	-0.00**	0.00*	-0.00	0.00*	-0.00	0.00	-0.00	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Access to finance	0.06***	0.16***	0.03	0.12**	0.08***	0.12**	0.07	0.11*	0.06*
	(0.02)	(0.03)	(0.02)	(0.06)	(0.02)	(0.06)	(0.06)	(0.06)	(0.03)
Labor Market	-0.03	-0.03	-0.04	0.26	0.02	0.24	-0.11	0.26	0.04
	(0.05)	(0.08)	(0.06)	(0.17)	(0.06)	(0.17)	(0.15)	(0.17)	(0.08)
Transport	-0.00	0.00	0.02	0.05	-0.01	0.05	-0.01	0.05	-0.01
	(0.03)	(0.04)	(0.03)	(0.09)	(0.03)	(0.09)	(0.08)	(0.09)	(0.04)
Exports	0.00	0.00	-0.00	0.00	0.00***	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Inputs imports	0.00***	0.00***	0.00	-0.00	0.00***	-0.00	0.00***	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Growth (t-1)	-0.07	0.01	-0.06	3.47***	-0.02	3.44***	-0.81*	3.49***	0.16
	(0.07)	(0.12)	(0.09)	(0.43)	(0.17)	(0.43)	(0.47)	(0.43)	(0.24)
GDP per capita growth (t-1)	0.07	-0.02	0.07	-3.69***	0.02	-3.67***	1.00**	-3.72***	-0.18
	(0.07)	(0.11)	(0.09)	(0.42)	(0.18)	(0.43)	(0.48)	(0.42)	(0.25)
Trade openness (t-1)	0.00**	0.00	0.00***	-0.05***	-0.01**	-0.05***	0.05***	-0.05***	-0.04***
	(0.00)	(0.00)	(0.00)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)
FDI (t-1)	-0.01***	0.00	-0.02***	0.23***	-0.03	0.23***	-0.19***	0.23***	-0.03
	(0.00)	(0.00)	(0.00)	(0.04)	(0.02)	(0.04)	(0.06)	(0.04)	(0.03)
Instruments									
Electricity losses (growth rate)				0.01***		0.01***		0.01***	
				(0.00)		(0.00)		(0.00)	
Observation	4368.00	4243.00	4260.00	3123.00	3123.00	3081.00	3081.00	3087.00	3087.00
F-stats	1255.55	253.79	712.48		784.61		77.62		383.16
Kleibergen-Paap rk LM statistic					43.08		41.67		42.95
Chi-sq(2) P-value					0.00		0.00		0.00
Kleibergen-Paap rk Wald F statistic					44.18		42.65		44.11
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2.6: Effect of production loss due to electricity shortages on unskilled workers, skilled workers and temporary workers

	Dependent variables : Unskilled workers, skilled and temporary workers								
	Linear fixed-effects model			Instrumental variables for panel-data models					
	Unskilled workers	Skilled workers	Temporary workers	Unskilled workers		Skilled workers		Temporary workers	
	Model 1	Model 2	Model 3	First Stage	Model 4	First Stage	Model 5	First Stage	Model 6
Production loss	-0.06***	-0.00	0.07***		-0.38**		-0.22**		-0.53***
	(0.01)	(0.01)	(0.02)		(0.16)		(0.10)		(0.20)
Domestic private	0.00***	-0.00	0.00	-0.00	0.00	-0.00*	-0.00*	-0.00*	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Foreign private	0.00***	-0.00	0.00	-0.00*	0.00	-0.00**	-0.00	-0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Government	0.00	0.00	0.01***	0.00	0.00	0.00	0.00	0.00	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Medium firms	1.00***	0.95***	0.50***	-0.14**	1.04***	-0.14**	0.93***	-0.13**	0.44***
	(0.04)	(0.03)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.05)	(0.07)
Large firms	2.06***	2.06***	1.42***	-0.32***	1.93***	-0.31***	1.98***	-0.34***	1.28***
	(0.08)	(0.08)	(0.10)	(0.08)	(0.12)	(0.08)	(0.09)	(0.08)	(0.14)
Employment(t-3)	0.00***	0.00***	0.00*	0.00	0.00***	-0.00	0.00***	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Sales(t-3)	0.00	0.00**	-0.00***	-0.00	0.00	-0.00	0.00*	-0.00	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Access to finance	0.04	0.01	0.34***	0.11*	0.03	0.11*	0.06	0.12**	0.43***
	(0.05)	(0.04)	(0.06)	(0.06)	(0.06)	(0.06)	(0.04)	(0.06)	(0.08)
Labor Market	-0.03	-0.05	0.28*	0.24	0.00	0.00	0.00	0.27	0.39*
	(0.14)	(0.10)	(0.16)	(0.17)	(0.16)	(.)	(.)	(0.17)	(0.21)
Transport	-0.07	0.02	0.03	0.04	-0.00	0.12	0.00	0.05	0.01
	(0.07)	(0.05)	(0.08)	(0.09)	(0.08)	(0.09)	(0.06)	(0.09)	(0.11)
Exports	-0.00	-0.00	0.01***	0.00	0.00	0.00	0.00	0.00	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Inputs imports	-0.00	0.00*	0.00***	-0.00	-0.00	-0.00	0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Growth (t-1)	-0.28	-0.04	0.61***	3.51***	0.36	3.54***	0.44	3.36***	1.89***
	(0.19)	(0.24)	(0.22)	(0.44)	(0.54)	(0.44)	(0.34)	(0.44)	(0.65)
GDP per capita growth (t-1)	0.37*	0.05	-0.58***	-3.74***	-0.36	-3.78***	-0.48	-3.58***	-2.01***
	(0.19)	(0.23)	(0.22)	(0.43)	(0.55)	(0.43)	(0.35)	(0.43)	(0.67)
Trade openness (t-1)	0.02***	-0.04***	0.01**	-0.05***	-0.06***	-0.06***	-0.03***	-0.05***	0.02
	(0.00)	(0.01)	(0.00)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
FDI (t-1)	-0.04***	-0.06**	-0.00	0.23***	-0.07	0.24***	0.01	0.23***	0.23***
	(0.01)	(0.03)	(0.01)	(0.04)	(0.07)	(0.04)	(0.04)	(0.04)	(0.08)
Instruments									
Electricity losses (growth rate)				0.01***		0.01***		0.01***	
				(0.00)		(0.00)		(0.00)	
Observation	4183.00	3439.00	4300.00	3041.00	3041.00	3007.00	3007.00	3081.00	3081.00
F-stats	116.69	175.70	41.30		70.58		141.36		22.71
R^2	0.46	0.63	0.31		0.29		0.49		-0.08
Kleibergen-Paap rk LM statistic					41.26		43.78		38.36
Chi-sq(2) P-value					0.00		0.00		0.00
Kleibergen-Paap rk Wald F statistic					42.22		45.07		39.17
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2.7: Effect of production loss due to electricity shortages on the total number of permanent and full time workers, non-production and production workers: self generation firms vs non self-generation firms

	Panel A: self-generation firms								
	Dependent variables : Total workers, non-production and production workers								
	Linear fixed-effects model			Instrumental variables for panel-data models					
	Total workers	Non-production workers	Production workers	Total workers		Non-production workers		Production workers	
	Model 1	Model 2	Model 3	First Stage	Model 4	First Stage	Model 5	First Stage	Model 6
Production losses	-0.02***	-0.02*	-0.03***		-0.11		0.65***		-0.25***
	(0.01)	(0.01)	(0.01)		(0.06)		(0.16)		(0.09)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments									
Electricity losses (growth rate)				0.01***		0.01***		0.01***	
				(0.00)		(0.00)		(0.00)	
Observation	2503.00	2432.00	2439.00	1914.00	1914.00	1896.00	1896.00	1898.00	1898.00
F-stats	612.58	114.31	356.50		407.35		38.70		197.53
Kleibergen-Paap rk LM statistic					29.44		29.98		30.05
Chi-sq(2) P-value					0.00		0.00		0.00
Kleibergen-Paap rk Wald F statistic					30.92		31.68		31.70
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Panel B: non self-generation firms								
	Dependent variables : Total workers, non-production and production workers								
	Linear fixed-effects model			Instrumental variables for panel-data models					
	Total workers	Non-production workers	Production workers	Total workers		Non-production workers		Production workers	
	Model 1	Model 2	Model 3	First Stage	Model 4	First Stage	Model 5	First Stage	Model 6
Production loss	-0.02**	-0.03*	-0.02*		-0.20*		0.79**		-0.35*
	(0.01)	(0.01)	(0.01)		(0.12)		(0.33)		(0.18)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments									
Electricity losses (growth rate)				0.01***		0.01***		0.01***	
				(0.00)		(0.00)		(0.00)	
Observation	1862.00	1807.00	1817.00	1206.00	1206.00	1183.00	1183.00	1187.00	1187.00
F-stats	540.64	126.26	294.36		267.25		32.40		124.56
R^2	0.89	0.72	0.83		0.81		-0.16		0.66
Kleibergen-Paap rk LM statistic					12.47		10.53		11.48
Chi-sq(2) P-value					0.00		0.00		0.00
Kleibergen-Paap rk Wald F statistic					11.72		9.86		10.83
Country fixed effect	Yes	Yes	Yes		Yes		Yes		Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2.8: Effect of production loss due to electricity shortages on unskilled workers, skilled and temporary workers: self generation firms vs non self-generation firms

	Panel A: self-generation firms									
	Dependent variables : Unskilled workers, skilled and temporary workers									
	Linear fixed-effects model			Instrumental variables for panel-data models						
	Unskilled workers	Skilled workers	Temporary workers	Unskilled workers		Skilled workers		Temporary workers		
	Model 1	Model 2	Model 3	First Stage	Model 4	First Stage	Model 5	First Stage	Model 6	
Production loss	-0.09***	0.01	0.09***		-0.44**		-0.21*		-0.63***	
	(0.02)	(0.01)	(0.02)		(0.18)		(0.12)		(0.24)	
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Instruments										
Electricity losses (growth rate)				0.01***		0.01***		0.01***		
				(0.00)		(0.00)		(0.00)		
Observation	2389.00	2107.00	2472.00	1868.00	1868.00	1886.00	1886.00	1891.00	1891.00	
F-stats	57.36	83.82	16.02		39.24		63.87		8.11	
R^2	0.46	0.57	0.24		0.22		0.41		-0.37	
Kleibergen-Paap rk LM statistic					29.47		30.35		26.20	
Chi-sq(2) P-value					0.00		0.00		0.00	
Kleibergen-Paap rk Wald F statistic					31.19		32.06		27.30	
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	

	Panel B: non self-generation firms								
	Dependent variables : Unskilled workers, skilled and temporary workers								
	Linear fixed-effects model			Instrumental variables for panel-data models					
	Unskilled workers	Skilled workers	Temporary workers	Unskilled workers		Skilled workers		Temporary workers	
	Model 1	Model 2	Model 3	First Stage	Model 4	First Stage	Model 5	First Stage	Model 6
Production losses	-0.05*	-0.03	0.04		-0.21		-0.25		-0.18
	(0.03)	(0.02)	(0.03)		(0.34)		(0.20)		(0.34)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments									
Electricity losses (growth rate)				0.01***		0.01***		0.01***	
				(0.00)		(0.00)		(0.00)	
Observation	1789.00	1327.00	1827.00	1171.00	1171.00	1180.00	1180.00	1187.00	1187.00
F-stats	57.15	83.85	23.65		28.03		66.02		16.19
R^2	0.47	0.68	0.35		0.33		0.54		0.23
Kleibergen-Paap rk LM statistic					10.59		11.27		11.94
Chi-sq(2) P-value					0.00		0.00		0.00
Kleibergen-Paap rk Wald F statistic					9.84		10.56		11.25
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2.9: Effect of the local production losses due to electricity shortages on employment and productivity

	Dependent variables : All employment variables					
	Total workers	Non-production workers	Production workers	Unskilled workers	Skilled workers	Temporary workers
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Local production loss	-0.06***	-0.04***	-0.07***	-0.03**	-0.03**	-0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Local domestic private	0.00***	-0.00	0.01***	0.00***	0.00***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local foreign private	0.02***	0.01***	0.02***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local government share	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local employment(t-3)	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local sales(t-3)	0.00***	0.00*	0.00***	0.00*	0.00*	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local access to finance	1.08***	1.01***	0.98***	0.92***	0.92***	0.88***
	(0.04)	(0.05)	(0.05)	(0.06)	(0.06)	(0.07)
Local labor Market	0.41***	0.50***	0.39**	-0.00	-0.00	0.57**
	(0.16)	(0.18)	(0.17)	(0.20)	(0.20)	(0.26)
Local transport	0.15*	0.07	0.23***	0.09	0.09	0.35***
	(0.08)	(0.09)	(0.08)	(0.11)	(0.11)	(0.13)
Local exports	0.00***	0.00***	0.00***	0.00***	0.00***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local inputs imports	0.01***	0.01***	0.01***	0.01***	0.01***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Growth (t-1)	-0.48***	-0.54***	-0.44***	-0.07	-0.07	0.42***
	(0.08)	(0.10)	(0.10)	(0.19)	(0.19)	(0.14)
GDP per capita growth (t-1)	0.48***	0.52***	0.44***	0.05	0.05	-0.41***
	(0.08)	(0.10)	(0.09)	(0.19)	(0.19)	(0.14)
Trade openness (t-1)	0.01***	0.01***	0.01***	-0.03***	-0.03***	0.00
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)
FDI (t-1)	-0.01***	0.00	-0.02***	-0.05***	-0.05***	0.00
	(0.00)	(0.00)	(0.00)	(0.02)	(0.02)	(0.01)
Observation	9727.00	8864.00	8915.00	7241.00	7241.00	9468.00
LR test	256.90***	90.39***	172.51***	77.85***	77.85***	31.29***
Log likelihood	-11452.08	-11484.48	-10908.04	-9591.07	-9591.07	-16169.77
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country random effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry random effect	Yes	Yes	Yes	Yes	Yes	Yes

Table 2.10: Effect of the local production losses due to electricity shortages on unskilled workers

	Dependent variables : Unskilled workers														
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15
Local production loss	-0.20***	-0.19***	-0.16***	-0.16***	-0.11***	-0.11***	-0.12***	-0.12***	-0.12***	-0.12***	-0.11***	-0.12***	-0.12***	-0.13***	-0.11***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Local domestic private		-0.02***	0.00*	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local foreign private			0.03***	0.03***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local government share				0.03***	0.02***	0.02***	0.02***	0.02***	0.02***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01**
				(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local employment(t-3)					0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
					(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local sales(t-3)						0.00	0.00	0.00	0.00	0.00	0.00	0.00*	0.00*	0.00	0.00
						(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local access to finance							1.02***	1.01***	1.00***	0.99***	0.92***	0.90***	0.91***	0.89***	0.87***
							(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Local labor Market								0.49**	0.41*	0.42*	0.45**	0.43*	0.44**	0.38	0.32
								(0.23)	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)	(0.25)	(0.25)
Local transport									0.33***	0.33***	0.29**	0.30**	0.31***	0.35***	0.32**
									(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.13)	(0.13)
Local exports										0.00***	0.00**	0.00**	0.00**	0.00**	0.00***
										(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local inputs imports											0.01***	0.01***	0.01***	0.01***	0.01***
											(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Growth (t-1)												0.08***	-0.37***	-0.56***	-0.56***
												(0.01)	(0.11)	(0.15)	(0.15)
GDP per capita growth (t-1)													0.44***	0.64***	0.64***
													(0.11)	(0.14)	(0.14)
Trade openness (t-1)														0.01***	0.02***
														(0.00)	(0.00)
FDI (t-1)															-0.04***
															(0.01)
Observation	9918.00	9911.00	9911.00	9911.00	9860.00	9688.00	9686.00	9686.00	9686.00	9683.00	9675.00	9675.00	9675.00	8650.00	8650.00
LR test	96.74	76.64	59.43	58.36	27.04	31.80	25.37	25.74	26.80	29.21	30.10	46.49	40.05	34.18	25.59
Log likelihood	-17285.56	-17085.62	-16951.04	-16924.65	-16317.60	-15952.36	-15831.00	-15828.60	-15824.65	-15813.13	-15768.04	-15713.14	-15705.06	-14106.41	-14082.69
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country random effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry random effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2.11: Effect of the local production losses due to electricity shortages on skilled workers

	Dependent variables : Unskilled workers														
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15
Local production loss	-0.15***	-0.13***	-0.12***	-0.12***	-0.05***	-0.04***	-0.06***	-0.06***	-0.06***	-0.05***	-0.04***	-0.04***	-0.04***	-0.03**	-0.03**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Local domestic private		-0.02***	-0.00***	0.00	0.00***	0.00	0.00	0.00	0.00	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local foreign private			0.02***	0.02***	0.02***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local government share				0.03***	0.03***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***
				(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local employment(t-3)					0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
					(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local sales(t-3)						0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00*	0.00*
						(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local access to finance							1.06***	1.06***	1.05***	1.02***	0.96***	0.97***	0.96***	0.91***	0.92***
							(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Local labor Market								-0.10	-0.13	-0.09	-0.06	-0.06	-0.06	-0.00	-0.00
								(0.19)	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)	(0.21)	(0.20)
Local transport									0.12	0.13	0.08	0.08	0.08	0.12	0.09
									(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.11)	(0.11)
Local exports										0.01***	0.01***	0.01***	0.01***	0.00***	0.00***
										(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Local inputs imports											0.01***	0.01***	0.01***	0.01***	0.01***
											(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Growth (t-1)												-0.01*	0.13	-0.26	-0.07
												(0.01)	(0.14)	(0.18)	(0.19)
GDP per capita growth (t-1)													-0.14	0.21	0.05
													(0.14)	(0.18)	(0.19)
Trade openness (t-1)														-0.03***	-0.03***
														(0.01)	(0.01)
FDI (t-1)															-0.05***
															(0.02)
Observation	8494.00	8488.00	8488.00	8488.00	8447.00	8284.00	8283.00	8283.00	8283.00	8278.00	8270.00	8270.00	8270.00	7241.00	7241.00
LR test	188.76	150.09	148.71	149.68	84.79	89.53	113.69	113.97	113.42	106.04	112.82	107.61	108.07	79.64	77.85
Log likelihood	-12869.42	-12566.83	-12488.72	-12444.11	-11604.74	-11201.03	-11023.17	-11023.01	-11022.26	-10983.75	-10911.31	-10909.96	-10909.47	-9594.40	-9591.07
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country random effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry random effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Chapter 3

Infrastructure and Exports Promotion

This chapter is under-review in «The World Economy»

Abstract

This paper studies the effects of power outages and exchange rate undervaluation on the allocation of manufacturing firms between the domestic and the exports market. I apply the instrumental variables approach to a sample of 12,062 manufacturing firms operating in 33 sub-Saharan African countries. The main results show that a 1% increase in the length of power outages reduces the share of exports in total sales by 0.939 percentage points. An undervaluation of 1% leads to an increase in the share of exports by 0.540 percentage points. The collateral damage effects show a negative impact of power outages and exchange rate undervaluation on the share of foreign inputs and a positive effect on the share of domestic inputs in the total purchase of inputs. Moreover, power outages and exchange rate undervaluation affect more the share of exports of firms in countries with low access to electricity, non-innovative firms, firms making less self-generation and firms operating in non-resource-rich countries. The robustness check indicates that the access to electricity and the exchange rate (undervaluation and depreciation) are substitutes. Indeed, a 1% improvement in electricity access per population reduces the positive impact of exchange rate undervaluation and depreciation on the share of exports by 0.172 and 0.583 percentage points, respectively.

3.1 Introduction

The allocation of resources from the informal to the manufacturing sector is viewed as a natural path to economic development (Murphy et al., 1989*b*; Lewis, 1954). The inter-sectoral movement of resources to manufacturing firms increases total factor productivity. A rise of productivity causes wage growth and therefore an improvement in the standard of living (McMillan et al., 2014; McMillan & Headey, 2014). Nevertheless, this process of structural change has failed to occur in sub-Saharan Africa (SSA). In some cases, resources move from the manufacturing to the informal sector (McMillan et al., 2014). The intra-sectoral allocation of resources is also an important factor for economic growth and improves the standard of living. Indeed, a movement of manufacturing firms from the domestic to the export market is seen as source of income growth in small countries.[1] This is explained by the fact that, exporters are more productive than non-exporters, allowing them to have: an efficient production structure, more jobs, better jobs, better wages, and rapid growth (Bernard, 1995).[2] More precisely, entering the export market improves the productivity of new entrants (Fafchamps et al., 2007; Van Biesebroeck, 2005; Greenaway et al., 2002; Aw et al., 2000; Bigsten et al., 2000). Although exporting firms perform better than non-exporting firms, SSA is the worst performing region in the world in terms of manufacturing exports (Figure 4.1). Its manufacturing exports are 95 times less than Asia, 82 times less than Europe, 19 times less than North America, and 8 times less than Latin America.

Since manufacturing exports are important to improve the standard of living, some studies advocate real exchange rate undervaluation policies as a tool for exports expansion and economic growth in developing countries.[3] According to Rodrik (2016*a*) and Johnson et al. (2010), the undervaluation of exchange rate, as a substitute for industrial policy, could be the most effective tool to boost industrialization and thus growth in Africa. For Rodrik (2016*a*), an undervaluation of 20% repre-

[1] The terms firms, enterprises and companies have the same sense in this paper, so they are used alternately.

[2] See also: Bernard & Jensen (1999) and Schank et al. (2007).

[3] For the sake of simplicity, we use in some cases the term "undervaluation" without accompanying it with "real exchange rate", but undervaluation clearly concerns the real exchange rate.

sents a 20% subsidy to industries allowing African manufacturing firms to compete with Chinese and Vietnamese exporters both in the domestic and exports markets. Moreover, Freund et al. (2012) show that, an undervaluation of real exchange rate by about 25% should give a large and immediate boost to manufacturing exporters in developing countries. In summary, the exchange rate undervaluation, by decreasing prices, would give a competitiveness advantage to manufacturing firms operating in small countries like those in SSA. The competitive gain for firms would be explained by the fact that undervaluation acts as a subsidy to manufacturing firms. Such a subsidy would reduce or eliminate the negative effects of some constraints related to the poor quality of the infrastructure service on manufacturing firms' activities.[4] This would allow exporting firms to increase their foreign sales and new firms to enter the export market.

From the above analyses, three interesting questions arise. First, even if an undervalued exchange rate could have a positive effect on the intra-sectoral allocation of firms, is this impact sufficient to eliminate the negative effect of the poor quality of infrastructure service? Second, would the ability of undervaluation to remove the negative effects of infrastructure on the movement of manufacturing firms to the export market depend on countries and/or firms' characteristics? Third, would exchange rate undervaluation also cause competitiveness losses by reducing imports of inputs, which are an important source of productivity in developing countries?[5] This paper addresses these questions by conducting a comparative study between the effects of the quality of electricity infrastructure service and those of undervaluation on the intra-sectoral allocation of manufacturing firms. More specifically, it studies the effects of power outages (the measure of the quality of electricity service) and exchange rate undervaluation on the share of manufacturing exports in total sales and that of domestic sales. For this purpose, the country and industry fixed effects instrumental variables (IVFE) approach is applied on a sample of 12,062 manufacturing firms in 33 SSA countries between 2006-2019. There are many reasons for choosing to analyze the effects of exchange

[4]See for example Rodrik (2016*a*).
[5]See: Goldberg et al. (2010).

rate undervaluation/depreciation and electricity infrastructure. For exchange rate policies (devaluation, undervaluation, depreciation), they are part of the economic history of developing countries in general, and African countries in particular. The most illustrative case in terms of its magnitude (50% or 100% in national currency) is the devaluation of the CFA franc against the French franc in 1994 in the WAEMU countries.[6] There have also been cases of devaluation in other African countries, with devaluations ranging from 15% to 70%.[7] Although these exchange rate policies were implemented in the 1980s and 1990s, they continue to fuel the current economic debate through both their effects on firm competitiveness and their socio-economic impacts. These policies have also been implemented in Japan, South Korea, Taiwan and Singapore, but after, there was massive investments in infrastructure to boost the growth of manufacturing firms (Nayyar, 2019). The issue of electricity infrastructure is important in SSA for four main reasons. First, SSA is the region of the world with the lowest access to electricity per population (Figure 4.2).[8] Second, it has the most unequal access to electricity between the rural and urban populations (Figure 4.3 & 4.4).[9] Third, power outages are considered by manufacturing firms in SSA to be the most important barrier to their business (Figure 4.5). Fourth, the services of infrastructure like electricity enter in manufacturing production as inputs, therefore, as source of productivity. Thus, a poor quality of these services could cause a productivity loss, and then a competitiveness loss in manufacturing firms. I assume that the competition should be tougher in the export market than the domestic market in developing economies like those in SSA.[10] Hence, the loss of competitiveness could lead some manufacturing companies to focus more on the domestic market at the expense of the export market. Therefore, in the context of exchange rate undervaluation, the policymakers have to ensure that the competitiveness losses due to the poor quality of electricity services is offset by the competitive gain due to the undervaluation. The effectiveness

[6] See: Devarajan (1997).

[7] See: Kimaro (1988).

[8] The term SSA refers to sub-Saharan Africa, but I sometimes use it to say SSA countries i.e., sub-Saharan African countries.

[9] For more explanation, see the next section.

[10] See the section about theoretical framework.

of exchange rate undervaluation should, therefore, depend on its ability to remove the negative effect of the poor quality of electricity service.

To the best of my knowledge, there is no article simultaneously studying the effects of power outages and exchange rate undervaluation on firms' allocation between the export and the domestic market. The existing literature focuses on the individual effects of these two variables. The first includes a number of articles examining the impact of power outages on business performance, such as productivity, sales, investment and employment. (Cole et al. 2018; Mensah, 2018; Allcott et al. 2016; Fisher-Vanden et al., 2015; Alam 2013; Steinbuks & Foster, 2010; Reinikka & Svensson, 2002). The second wave includes two sets of studies. The first concerns a number of papers investigating the role of exchange rate depreciation or undervaluation in exports and economic growth (Freund et al.; 2012; Eichengreen, 2007; Rodrik, 2007; Hausmann et al., 2005; Bernard & Jensen, 2004; Dooley et al., 2004; Sekkat & Varoudakis, 2000; Arslan & Van Wijnbergen, 1993; Bayoumi, 1999). The second focuses on the correlation between overvaluation and economic development (Acemoglu et al., 2003; Loayza et al., 2004; Benaroya & Janci, 1999; Razin & Collins, 1997; Dollar, 1992; Cottani et al., 1990). According to them, the more a currency is overvalued, the lower the GDP per capita.

The contribution of this article is twofold. First, I examine the effects of power outages and exchange rate undervaluation simultaneously on the intra-sectoral allocation of manufacturing firms. This enables a comparison between the effects of policies that promote manufacturing exports and the impacts of domestic constraints that discourage them. It also allows to understand if there is some interactions between the effects of the two variables. Second, the literature on the effects of exchange rate undervaluation focuses on aggregate exports, which may mask some heterogeneities across firms and industries. To avoid this issue, the empirical approach combines the country (undervaluation variable) and firm-level data (export variable). This approach also addresses the problem of non-exogeneity of instruments that could be due to a direct link between them and the performance of firms by using other macroeconomic variables as control.[11]

[11]See the discussion on instruments in the empirical strategy.

The results on the overall sample suggest that power outages negatively affect the share of exports in total sales while the impact on the share of domestic sales is not significant. More specifically, a 1% increase in the length of power outages reduces the share of exports by 0.939 percentage points. For exchange rate undervaluation, it positively impacts the share of exports while its effect on the share of domestic sales is not significant. An undervaluation of 1% leads to an increase in the share of exports by 0.540 percentage points. The results on the overall sample show that the poor quality of electricity service discourages manufacturing firms from selling their products abroad while the undervaluation encourages them to export more. However, the positive effect of undervaluation is apparently offset by the negative effect of power outages. Indeed, the effect of power outages on the share of exports (-0.939) is approximately two times higher than that of exchange rate undervaluation (0.540). The collateral damage effects show a negative impact of power outages and undervaluation on the share of foreign inputs and a positive effect on the share of domestic input in the total purchase of inputs. A 1% increase in power outages and exchange rate undervaluation reduces the share of foreign inputs by 0.793 and 0.357 percentage points, respectively. However, it increases the share of domestic inputs by 0.638 and 0.332 percentage points, respectively. In addition to being unable to eliminate the negative effects of power outages, undervaluation is a barrier to foreign inputs utilization. The effect of power outages and that of undervaluation increase drastically in countries with poor access to electricity compared to those with better access to electricity. In addition, electricity shortages and undervaluation have a greater effect in non-innovative firms than innovative firms. For firms that rely heavily on self-generation, the effects of power outages and undervaluation are small compared to firms that do less self-generation. These results show that firms making efforts to introduce new production processes that could generate productivity gains and therefore competitive gains are less affected by power outages and exchange rate undervaluation. Also, firms that make efforts to reduce electricity shortages by producing a part of their electricity consumption are less affected by power outages and exchange rate undervaluation than those that do not make such efforts. Furthermore, manufacturing companies in non-resource-rich countries are more affected by power outages and undervaluation than those in resource-rich countries. The macroeconomic measure of electricity service quality confirms the previous results. Indeed, a 1% increase in the proportion of the population that has access to electricity increases the share of exports by 0.582 percentage points. Considering the interaction variable, a 1% improvement in electricity access per population reduces the impact of exchange rate undervaluation and depreciation on the share of exports by 0.172 and 0.583 percentage points, respectively. From the above results, it appears that when a country improves its access to electricity, the positive effect of undervaluation decreases. Undervaluation is therefore an effective subsidy for manufacturing firms only in the case of countries with low access to electricity. Countries with better access to electricity have less need for exchange rate undervaluation as a source of competitiveness to increase their export share. So, what really matters is improving the access to electricity rather than undervaluing the real exchange rate. Hence, the exchange rate policy and policies improving electricity access are substitutes.

The rest of the paper is organized as follows: Section 3.2 presents the issues of: exporters and non-exporters performance, electricity access and power outages in sub-Saharan Africa. Section 3.3 explains how power outages and exchange rate undervaluation theoretically affect the allocation of manufacturing firms between the export and the domestic market. Section 3.4 describes the variables and data used in the paper. Section 3.5 presents the specification approach. The main results are presented in Section 3.6. Section 3.7 and 3.8 concern the sensitivity tests and robustness, respectively. Finally, Section 3.9 concludes.

3.2 Background: Exporters and non-exporters, access to electricity and power outages in sub-Saharan Africa

This section can be organized into two main parts. First, it focus on the issue of manufacturing exports in Africa. Second, it provides a statistical analysis of the availability and the quality of electricity service in SSA.

Table 3.1 presents a comparative analysis between exporting and non-exporting firms. Exporters in SSA perform better than non-exporters. In terms of sales, exporting firms sell about 8 times more than non-exporting firms. The average total sales of firms that export is about $38.5 million while this amount is $4.85 million for non-exporters. The average number of workers in exporting firms (248.43) is 4 times more than that in non-exporting firms (60.62). In terms of employment structure, both exporters and non-exporters employ more production workers than non-production employees. The average number of production workers in exporting firms is 208.85 while that of non-production employees is 44.22. Similarly, in non-exporting firms, the average number of production employees is 44.77 while that of non-production workers is 14.11. Nevertheless, the production and non-production workforce in exporting firms are 4 and 3 times higher than those in non-exporting firms, respectively. With 151.87 skilled workers on average, the exporters employ 5 times more skilled employees than non-exporters. The exporters also employ more unskilled workers and more women than non-exporters. Finally, the average number of workers that the firms would like to hire is about 8 times greater for exporters (47.11) than non-exporters (5.47). Although exporting firms perform better than non-exporting firms, SSA is the worst performing region in the world in terms of manufacturing export (Figure 3.1). Indeed, it exports 95 times less than Asia, 82 times less than Europe, 19 times less than North America, and 8 times less than Latin America.

In all regions of the world except SSA, more than 90% of the population has access to electricity (Figure 3.2). To be more exact, 100% of the population in North

America, 99.99% in Europe and Central Asia... and 94.40% in South Asia have access to electricity. This proportion is only 46.75% in SSA making it the region where the population has limited access to electricity. For SSA, Figure 3.2 hides an unequal access to electricity between the rural and urban populations. Indeed, 77.86% of the urban population has access to electricity (Figure 3.3), compared to only 28.06% of the rural population (Figure 3.4). Such an inequality is not visible in the rest of the world. In other regions, more than 90% of the rural and urban populations have access to electricity (Figures 3.3 & 3.4). From the previous stylized facts, SSA is the most unequal region in terms of access to electricity between the urban and the rural populations. It is also the region with the lowest rate of electricity access per population. In addition to the lack and the inequality of electricity access, the poor quality of electricity service is a severe constraint for manufacturing firms in SSA. Among the biggest obstacles to the operations of manufacturing firms in SSA, electricity is the most important (Figure 3.5).

3.3 Theoretical framework

Power outages and exchange rate undervaluation affect the allocation of firms through the intensive margin and the extensive margin. The intensive margin is defined as the expansion of existing firms in terms of sale in the export and the domestic market. For the extensive margin, it refers to the entry of firms in the two markets.

3.3.1 Power outages and the allocation of manufacturing firms across the export and the domestic market

As electricity is an input for manufacturing production, its services may contribute to productivity growth. The poor quality of these services, measuring by the length of power outages, could reduce firms' productivity.[12] The productivity loss due to power outages would decrease firms' sales and the possibility for new enterprises

[12] See for example Cole et al. (2018).

to enter in manufacturing sector. It may also be an incentive for firms to move from one market to another. Indeed, the decrease of productivity reduces the competitiveness of manufacturing firms both in the exports and the domestic market. However, for small economies like those in SSA, the extent of competitiveness in exports market should be more important than that in domestic market. Thus, the productivity loss due to power outages would make it more difficult to participate in export market than domestic market. Therefore, the companies that exist in the two markets would tend to sell more in domestic markets at the expense of export markets. In certain cases, some firms could exit the export market to stay or enter into the domestic market. For firms selling all of their products on the domestic market, power outages could prevent them from entering the exports market. Thus, even if a firm sells 100% of its products in the domestic market, power outages could be an incentive to stay there instead of exporting. Hence, the length of power outages should positively affect the share of domestic sales and negatively impact the share of exports in total sales.

In addition to encouraging firms to stay or to move towards domestic market, power outages can have a collateral damage effect on exports. Indeed, electricity shortages impose transaction costs on businesses increasing the cost of production. In order to reduce high production costs, firms could turn to cheaper production factors such as unskilled labor and less technological inputs. Assuming that foreign inputs would be more technological and thus more expensive than domestic ones in developing countries like SSA, firms could replace the imports of foreign inputs with the purchases of domestic inputs. Hence, power outages may reduce the share of foreign inputs and increase that of domestic ones in the total purchase of inputs. It should be noted that, the intermediate inputs, especially those imported, are an important source of productivity for manufacturing firms (Grossman & Helpman, 1991; Markusen, 1989; Romer, 1987; Ethier, 1982; Halpern et al., 2015; Goldberg et al., 2010; Amiti & Konings; Amiti & Konings). According to Halpern et al. (2015), the imports of intermediate inputs accounted for 30% of total factor productivity growth in Hungary and about 50% of this effect was due to importers. Moreover, the reduction of trade tariffs has led to higher imports of new varieties of inputs in India, which in turn have accounted for 31% of new varieties of finished goods (Goldberg et al., 2010). So, if the imported inputs are used exclusively to produce the export products, then the decline in the import of inputs due to power outages will lead to productivity loss and then to competitiveness loss which would further reduce the share of exports.

3.3.2 Real exchange rate undervaluation and the allocation of manufacturing firms between the export and the domestic market

Theoretically, a depreciation, more strongly, an undervaluation of exchange rate positively impacts manufacturing firms because it improves their competitiveness through the reduction of prices (Rodrik, 2016*a*; Freund et al., 2012; Rodrik, 2008; Hausmann et al., 2005). More precisely, undervaluation moves resources from the non-tradable to the tradable sectors. Thus, it would increase the amount of manufacturing sales in both domestic and export markets. In terms of proportion, Freund et al. (2012) argue that, an undervalued exchange rate shifts resources to the export sector. Therefore, when the exchange rate is undervalued, one can expect an increase in the share of exports in total sales relative to that of domestic sales. Furthermore, one might also expect that the undervaluation allows domestic manufacturing firms to enter export markets or allows entrepreneurs outside of markets to enter the export market. According to Freund et al. (2012) and Rodrik (2016*a*), an undervaluation reduces or eliminates the effects of distortions and constraints - like power outages - reducing manufacturing firms' performance. However, to eliminate the effects of power outages, the positive influence of exchange rate undervaluation on the export share must be greater than or equal to the negative impact of power outages. Moreover, the ability of undervaluation to eliminate the negative effects of electricity shortages may depend on firms and countries characteristics. Indeed, firms that make efforts to increase their productivity and thus their competitiveness may have less need for undervaluation. Conversely, firms that do not make such efforts may use undervaluation to improve their competitiveness. Such efforts may be the introduction of a new production process (innovation) or the use of a generator to prevent power outages.

Yet, the undervaluation of the exchange rate could have collateral damage through lower input imports due to higher prices. As these inputs are used in the production process, their inaccessibility due to undervaluation could lead, in the long run, to significant productivity losses and thus competitiveness losses. Since these competitiveness losses are due to productivity losses, they could be greater than the competitiveness gains from undervaluation, which is due to a simple price reduction. To summarize, the drop in inputs imported would negatively affect the production structure of firms, whereas the drop in prices that increases firms exports would be temporary. Indeed, the constraints related to the production process of firms are structural problems, while an exchange rate policy can, at best, be a short-term solution. According to Rodrik (2016*a*), maintaining an undervalued exchange rate requires an appropriate monetary/fiscal policy framework. In most SSA countries, deep institutional reforms would be required to achieve such a macroeconomic framework. However, even if these economies were able to build the necessary institutions to maintain the undervalued exchange rate, this would not solve the infrastructure problems, which remain structural. Moreover, if all African countries implement an undervaluation policy, it would result in real exchange rate competition among them. This type of competition would, at best, ensure the success of a select number of countries.

3.4 Variables and data description

This paper focuses on both company and country specific data. The firm-level data are from the World Bank Enterprise Surveys (WBES). The macroeconomic variables are from Penn World Table 10.0, KOF globalization database and World Development Indicators (WDI).[13] About, 12,062 manufacturing firms in 33 SSA countries are studied between 2006-2019. The WBES concern the issues related to the

[13]For the contributions relating to the KOF trade globalization index see Gygli et al. (2019) and Dreher (2006).

business environment in developing countries, they allow for identifying the determinants of firms' performance. The stratification is based on three dimensions: sector, size, and the geographical location of firms. The surveys are carried out with the cooperation of the statistical office in each country covered.

3.4.1 Variable description

The variables description is mainly organized in two parts: firm variables and macroeconomic variables.

Firm's variables

The present subsection exhibits the set of firm variables used in this paper.

- **Firms allocation between the domestic and the foreign market**: The movement of manufacturing firms between two markets is defined in this paper as the increase or decrease in sales of a firm in one market relative to another. Thus, the more a firm sells in one market relative to another, the more it moves to the first market. Based on this concept, the allocation of manufacturing firms between the domestic and export markets is measured by the increase or decrease in the share of exports in total sales relative to that of domestic sales. The exports refer to the sales of manufactured goods whose immediate recipients are located outside the borders of country. The domestic sales concern the sales of manufactured products whose recipients are inside the country's borders. Furthermore, the movement of manufacturing firms between the domestic market of inputs and the foreign market of inputs is measured by the increase or decrease in the share of foreign inputs in total input purchases relative to that of domestic inputs. Foreign inputs concern the purchase of inputs whose sellers are located outside the borders of country. Domestic inputs correspond to the purchase of inputs whose sellers are inside the borders of country.

- **The quality of electricity service**: It is measured by the length of power outages experienced in each firm. Initially, this variable was monthly, I convert it to annual because the dependent variables are annual. The length of power outages is considered as key measure of electricity service because it matters more than the number of outages. The extent of the impact of power outages on the manufacturing production depends on their duration not on its number. Indeed, an outage lasting a few minutes would have a negligible effect on manufacturing production compared to an outage lasting several hours.

- **Capital ownership**: This firm characteristic measures the distribution of the company's ownership among the economic agents. I consider in this paper the share of capital that is held by: domestic economic agents (share owned by nationals), foreigners (share owned by foreigners) and government/state (share owned by government/state). This group of variables controls for heterogeneities that might exist between firms that are mainly owned by foreigners, domestic economic agents or by the government. Such differences may affect the probability of whether a firm exports or not. Indeed, it could be argued that a firm that is largely owned by foreigners would be more oriented toward foreign markets and one that is domestically owned would be more oriented toward the domestic market.

- **Firms' size**: Three dimensions represent the size of companies, namely small, medium and large. Small-sized and medium-sized firms employ 1 to 19 and 20 to 99 employees, respectively. Large-sized firms are those with 100 or more employees. If the size is associated with productivity and competitiveness, differences in size can also affect the ability of a firm to export or not.

- **Firms' locality**: This variable shows the size of the city in which a firm is operating. It is a dummy variable taking 1 if one firm is operating in large city and 0 otherwise. This dummy allows for controlling the agglomeration effect.

- **Sales 3 years ago**: This variable represents the amount of firms' sales three years before the survey. It allows to control the phenomenon of persistence.

Indeed, the increase in sales three years ago could be used to improve the competitiveness of companies to participate in the export market. In contrast, the decline in sales of firms three years ago may affect their future competitiveness and thus fail to participate more in the export market.

Macroeconomics variables

This subsection presents the macroeconomic variables from Penn World 10.0 database, WDI and KOF Globalization Index database.

- **Exchange rate undervaluation**: The exchange rate undervaluation is the macroeconomic variable of interest. To determine this variable, I use the method of Rajan & Subramanian (2011), Rodrik (2008), Johnson et al. (2006), Easterly & Levine (2003), which is summarized in three steps.

  First, I collect data on the variable "price level of output-side real GDP" from the Penn World table 10.0 as the measure of real exchange rate. This variable is expressed as one unit of local currency against an amount of dollars, thus, its inverse, named RER, is used allowing to study the impact of the undervaluation rather than the overvaluation. An increase in RER indicates that local currency is more depreciated while a decrease in RER means that the value of national currency is more appreciated compared to what is recommended by the purchasing power parity.

  Second, in order to take into account the Ballassa-Samuelson effect, I regress the RER on the level of economic development (GDP per capita), allowing to take into account the purchasing power parity.

$$RER_{i,t} = \beta GDPC_{i,t} + \delta_c + \Delta_t + U_{i,t} \tag{3.1}$$

  With: δ_c, Δ_t, $GDP_{Ci,t}$, $U_{i,t}$ corresponding to the country and year fixed effects, GDP per capita and the error term, respectively.

  In the final step, I calculate the measure of exchange rate undervaluation as the difference between the RER and its estimated values obtained from equation 3.1 ($\hat{RER}_{i,t}$).

$$Undervaluation_{i,t} = RER_{i,t} - \hat{RER}_{i,t} \tag{3.2}$$

With: $Undervaluation_{i,t}$ corresponding to the undervaluation index of the real exchange rate.

When the undervaluation measure is greater than 1, it indicates that the exchange rate is such that goods produced in the country are relatively cheap in dollar terms. Otherwise, the currency is overvalued. An increase in the undervaluation variable shows a trend to undervaluation, otherwise, there is a trend to overvaluation. For robustness, the RER is used as variable of interest instead of the undervaluation measure.

- **Access to electricity (%)**: This variable is the percentage of population with access to electricity. It represents the alternative macroeconomic measure of the electricity service quality used in the robustness model. A country where a large part of the population has access to electricity could mirror a situation where a large part of firms also have access to electricity.

- **Households and government consumption**: One of the main determinants of firms' sales is the domestic demand. If the increase in manufactured goods consumed by households and the government consists of domestic goods, domestic sales will increase. Hence, the shares of households consumption and the government consumption in GDP are used as control variables. These variables are all from Penn World 10.0 database.

- **Domestic investment**: The effect of domestic investment measured by the share of gross fixed capital formation in GDP is controlled. The investment in inputs by one firm is the final sale of other enterprises. So, I expect a positive impact of investment on manufacturing sales. However, the effect on the share of exports and that of domestic sales could be mitigated.

- **GDP per capita growth**: The growth of GDP per capita, from WDI, can measure both the gowth of income per capita and that of market size. As with income per capita, the expansion of GDP per capita could lead to an increase in the demand for domestic manufacturing products. As with market size, its growth offers opportunities for new firms to enter in the manufacturing sector.

- **GDP growth rate**: This variable measures the effect of the dynamism of an economy. It also takes into account the effect of the instruments on the performance of the companies which does not pass by the power outages.

- **Trade openness**: The country's outward orientation is controlled. The assumption is: countries that are more outward-oriented allow firms to export and import more. The outward-orientation of countries is measured by the De facto KOF trade globalization indicator.

- **The quality of institutions**: According to Azomahou et al. (2021), the quality of domestic institutions is an important determinant for the intensive and extensive margins of exports. I try to control for this effect. The quality of institutions is measured by the rule of law variable from WDI. It ranges from -2.5 (low rule of law) to 2.5 (high rule of law).

3.4.2 Data description

This subsection presents summaries for industries and countries.

Table 3.2 shows the representation of industries in the overall sample. The non-manufacturing and manufacturing industries represent 45.17% and 54.83% of the overall sample, respectively. The industry of wholesale and retail trade and that of food are the most represented in the total sample. In the specific case of the manufacturing sector, the labor-intensive industries tend to be more represented than capital-intensive industries. Indeed, the food industry is the largest with 2,957 firms, which accounts for 24.52% of manufacturing sample. Moreover, the wearing apparel and dressing industries represent 13.73% of manufacturing sample. The capital-intensive industry like manufacture of office and computing machinery is the least represented, accounting for 0.07% of the sample.

Table 3.3 shows the representation of countries in terms of firms surveyed. Two countries, namely Nigeria and Kenya are the most represented in the manufacturing sample. In total, 4,198 Nigerian firms are considered, this represents 16.98% of the manufacturing sample. The number of Kenyan firms is 2,220 manufacturing firms, representing 8.98% of the sample. The least represented countries are Gabon, Guinea-Bissau, and Togo with 0.56%, 0.63%, 0.93% of manufacturing firms, respectively.

Table 3.4, presents the aggregate statistics. It is organized into two parts namely enterprises and macroeconomic variables. On average, the enterprises in the sample tend to sell more in domestic country rather than foreign countries. Indeed, the average share of exports in total sales is 12.07% while that of domestic sales is 83.02%. The average annual length of power outages is 82.01 hours while the average number of power outages is 85.61. Firms tend to be, on average, domestic rather than foreign firms. The average share of capital held by nationals is 88.28% while that held by foreigners is 8.24%. The locality dummy is, on average, 0.38, showing that the firms tend to not be located in large cities. The undervaluation measure (-0.09), is on average, overvalued in SSA countries.

Table 3.6 presents the statistics of the dependent variables by couple (country, year). In all couples (country, year) except (Ethiopia, 2019), the share of domestic sales in total sales is considerably higher than that of exports (direct exports). Moreover, in most countries with at least two years of surveys, the export share tends to decline over time. For example, in Botswana, the share of direct exports declined by 233% from 2009 (26.89% of total sales) to 2017 (8.07% of total sales). For Madagascar, this reduction is 795% from 2009 (30.51% of total sales) to 2017 (3.41% of total sales). In the same time, the share of domestic sales in total sales has increased from 66.79% to 90.63% in Botswana and from 64.03% to 94.71% in Madagascar between 2009 and 2017.

Table 3.7 presents the summaries about the variables of interest by couple (country, year). Regarding the variables of power outages (in columns 1 & 2), there is heterogeneity between the couples (country, year). Some couples record a significant number of power outages while having a relatively short duration of outages (Cameroon2014; Liberia2013; Lesotho2013; Nigeria2013; Malawi2009; Namibia2009; Nigeria2009). Moreover, other couples have long length of outages with low number of outages (Mozambique2019; Senegal2019; Mauritania2015; Mali2015; Zimbabwe2015; Rwanda2012; Senegal2012; Angola2010; Kenya2010; Mauritius2010; Zambia2009; Ghana2008; Angola2006). With the exception of the couple (Togo, 2008), all couples (country, year) in the sample have strongly overvalued exchange rates. Indeed, the undervaluation indicator is significantly lower than 1 in all of these couples.

3.5 Empirical specification

I estimate the effect of power outages and exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market. The basic econometric model is:

$$Y_{fict} = \alpha + \beta P_{fict} + \sigma E_{ct} + \mu F_{fict} + \gamma X_{ct} + \delta_c + \theta i + \epsilon_{fict} \quad (3.3)$$

Where Y_{fict} represents either the share of exports in total sales (log) or the share of domestic sales in total sales (log) for firm f in industry i operating in country c at time t. Y_{fict} can also be the share of foreign inputs or that of domestic inputs in overall input purchases for firm f in industry i operating in country c at time t. P_{fict} and E_{ct} are the variables of interest. P_{fict} represents the enterprise variable of interest: the logarithm of the length of power outages in firm f located in industry i and operating in country c at time t. E_{ct} is the macroeconomic variable of interest corresponding to the logarithm of real exchange rate undervaluation or the logarithm of real exchange rate depreciation in country c at time t. F_{fict} is the vector of firm control variables for company f in industry i, country c at time t. X_{ct} is the vector of macroeconomic control variables for country c at time t. δ_c and θi are the country and industry fixed effects, respectively. ϵ_{fict} is an idiosyncratic error term. The ordinary least squares (OLS) approach with country and industry fixed effects is applied on equation 3.3. However, a major concern emerges from the previous specification. Indeed, the OLS with country and industry fixed effects do not take into account a possible endogeneity bias in the variables of interest. Thus, the challenge is to deal this issue in the firm-level variable of interest and in the macroeconomic variable of interest.

Concerning the endogeneity in the undervaluation measure, it could be explained by the existence of the reverse causality. I assume in equation 3.3 that, the real exchange rate undervaluation in time t makes manufacturing firms in SSA more competitive in time t. This would increase the share of exports in total sales relative to the share of domestic sales. However, one may argue that, the rise of manufacturing export in country c at year t could lead to an overvaluation or appreciation of the real exchange rate at the same year. Specifically, the more manufacturing firms in a country sell abroad, the more foreign currency will flow into that country affecting the value of the local currency. To deal with this, I use the one-period lag of the undervaluation measure. I assume that the performance of firms in terms of exports and domestic sales in country c at time t does not impact the real exchange rate in t-1.

There are two main reasons that may explain the endogeneity of the firm-level variable of interest. First, the length of power outages is self-reported by firms, so it could possibly be biased toward over- or under-estimation. Second, there may be a reverse causality between the length of power outages and the dependent variables. Indeed, I assume in equation 3.3 that an increase in the length of power outages causes a productivity losses and then a competitiveness losses in manufacturing firms. These losses would encourage manufacturing enterprises to turn more toward the domestic market at the expense of the export market. However, one can argue that the good performance of firms in terms of both exports and domestic sales provide incentive for states to improve the quality of electricity service reducing the length of power outages. To address this type of endogeneity, I apply the IVFE approach by using two instruments namely: temperature shock and precipitation shock. The instruments may affect the length of power outages in two main ways. First, a rise of temperature should increase the demand of households for electricity (Eskeland & Mideksa, 2009; De Cian et al. 2007; Scott & Huang, 2007; Pardo et al. 2002; Li & Sailor, 1995; Al-Zayer & Al-Ibrahim, 1996; Ayyash et al. 1985; Bolzern et al. 1982). The increase in electricity demand passes through the use of household appliances such as air conditioners, fans, freezers, refrigerators... Since the supply of electricity is limited in the short term, the rise of the demand should increase the occurrence of power outages. For example, an additional 1 degree Celsius of temperature increases the demand for electricity by 2 kWh per year and per capita (Eskeland & Mideksa, 2009). Second, in countries with hydro-electric dams, the dry season which is characterized by low precipitation - a rainfall decrease - leads to a reduction in the water flow of the river that feeds the hydro-electric dam (Cole et al. 2018; Mideksa & Kallbekken, 2010; Bye, 2008; Demers & Roy, 2006; Beldring et al. 2006). The reduction in water flow, by decreasing electrical production will lead to power outages if the demand for electricity does not decrease.

I therefore expect that the shock of temperature positively affects the length of power outages while the shock of precipitation negatively affects it. These instruments, being shock variables, are exogenous by nature. Moreover, it could be argued that they might not satisfy the exclusion restriction condition if their effects on the dependent variables pass through other channels. For example, a flood or earthquake shock may affect the aggregate level of economic activity, thus inhibiting the output of firms. They could also have sectoral effect. Indeed, in agrarian countries like those in SSA, a flood shock can reduce the agricultural production and therefore decrease the production of the food industry because of the lack of raw materials. Hence, the challenge is to take into account these weather effects on the performance of firms that do not pass through power outages. To do so, I introduce macroeconomic measures of firm performance (GDP growth and GDP per capita growth) among the control variables in the two step of instrumentation. The value added is one of the most relevant measures of firm performance as it shows how a firm contributes to the economic activity. Moreover, an important component of GDP is the sum of the value added of all firms regardless their industries and sectors. Putting GDP growth as well as GDP per capita growth among the explanatory variables prevents the instruments from being correlated with the error term through the firm performance channel. The weather effects that pass through other macroeconomic variables like household consumption and government consumption are also controlled. The combination of the company and country dimensions allows me to make this kind of control. The temperature or precipitation shocks for each couple (country, year) are determined as the deviation of the annual temperature or the annual precipitation from the historical average:

$$Shock\_Temperature_{c,t} = \frac{T_{c,t} - \bar{T}_{c,t}}{T_c^{SD}} \tag{3.4}$$

$$Shock\_Precipitation_{c,t} = \frac{Pr_{c,t} - \bar{Pr}_{c,t}}{Pr_c^{SD}} \tag{3.5}$$

$T_{c,t}$ and $Pr_{c,t}$ represent the annual temperature and the annual precipitation for country c at year t, respectively. $\bar{T}_{c,t}$ and $\bar{Pr}_{c,t}$ are the historical annual averages of temperature and precipitation in country c at year t (1961 is the historical year), respectively. Finally, T_c^{SD} and Pr_c^{SD} are the standard deviations of temperature and precipitation from 1961 to 2019 in county c. Thus, the IVFE is used. In the first step, the impacts of temperature and precipitation shocks on the length of power outages are estimated.

$$P_{fict} = \alpha + \beta Shock\_Temperature_{ct} + \Gamma Shock\_Precipitation_{ct} + \zeta E_{ct-1} + \eta F_{fict} + \rho X_{ct} + \delta_c + \theta i + \nu_{fict} \tag{3.6}$$

Where P_{fict} represents the endogenous firm-level variable in country c and time t (the logarithm of the length of power outages). E_{ct-1} is the lag (1) of the real exchange rate undervaluation or depreciation (log). Figures 3.6 show the relationship between the instruments and the variables of interest. As expected, the graphs reveal a positive correlation between the temperature shock and the length of power outages. However, the precipitation shock is negatively correlated to the length of power outages. The equation of the second step is :

$$Y_{fict} = \alpha + \Psi \widehat{P}_{fict} + \tau E_{ct-1} + +\chi F_{fict} + \phi X_{ct} + \delta_c + \theta i + \omega_{fict} \tag{3.7}$$

Where $\widehat{P}_{fict}$ is the fitted values of the length of power outages from the first stage. As expected, the length of power outages is negatively correlated to the share of exports in total sales and positively correlated to that of domestic sales (Figures 3.7). However, the exchange rate undervaluation is positively correlated to the share of exports and negatively correlated to that of domestic sales in total sales (Figures 3.8). Moreover, the length of power outages is negatively correlated to the share of foreign inputs and positively correlated to the share of domestic inputs in total purchase of inputs (Figures 3.9). Concerning the exchange rate undervaluation, it is negatively correlated to the share of foreign inputs and positively correlated to the share of domestic inputs in total purchase of inputs (Figures 3.10). Note that all the above correlations are statistically significant. The IVFE method is accompanied by two tests of validity for the instruments, namely the under-identification and weak identification tests. The first test determines whether the instruments are correlated with the variable suspected to be endogenous. The under-identification test is a Chi-square test based on the null hypothesis of no correlation between the endogenous variable and the instruments. Therefore, the instruments will be relevant if the null hypothesis is rejected by the Kleibergen-Paap rk LM statistic. The weak identification test allows to understand whether the instruments are weakly correlated with the potentially endogenous variable. Thus, the instruments used will be valid if the Kleibergen-Paap rk Wald F statistic is greater than all the critical values of Stock-Yogo.

3.6 Results

The main results regarding the effects of power outages and exchange rate undervaluation on the allocation of firms between the domestic and foreign markets are reported in Table 3.9 and Table 3.10. Table 3.9 presents the impacts of power outages and exchange rate undervaluation on the share of exports and that of domestic sales in total sales. The results of the OLS method are included in the two first columns. This method shows that the measure of undervaluation has a positive and statistically significant effect on the share of exports in total sales and a negative impact on that of domestic sales. An undervaluation of 1% leads to an increase of 0.454 (column 1) and a decrease of 0.504 (column 2) percentage points in the share of exports and the share of domestic sales in total sales, respectively. For power outages, they have no statistically significant effect on the allocation of firms between the domestic and export markets (column 1 & 2). Since these results are subject to a potential endogeneity bias, the IVFE method and the one-period lagged exchange rate undervaluation measure are used to account for this issue. From column 3 to 6, I begin by presenting the results related to the effects of power outages and then I examine the impacts of exchange rate undervaluation. The columns 3 and 4 concern the IVFE model in which the length of power outages is endogenous and affects the share of exports in total sales. The first stage equation of this model is reported in column 3. As expected, the shock of temperature has a positive and statistically significant effect on the length of power outages while the shock of precipitation negatively impacts it (column 3). In addition, the shock of temperature and precipitation are relevant as instruments because they passe the under-identification and weak identification tests (column 4). Indeed, the P-value of the under-identification test (Kleibergen-Paap rk LM statistic) rejects the null hypothesis of no correlation between instruments and the length of power outages. Simultaneously, the Kleibergen-Paap rk Wald F statistics for the weak identification test is higher than all the critical values of Stock-Yogo (19.93; 11.59; 8.75; 7.25). In column 4, the length of power outages has a positive and statistically significant effect on the share of exports in total sales. More precisely, an increase in the length of power outages by 1% causes a decline in the share of exports by 0.939 percentage points. The columns 5 and 6 show the results of the model in which the length of power outages is endogenous and affects the share of domestic sales in total sales. The first stage equation of this model is reported in column 5. The annual shock of temperature positively and significantly impacts the length of power outages while the annual shock of precipitation negatively affects it (column 5). Also, the instruments passe the validity tests (column 6). In column 6, although the sign of power outages' effect is positive, its impact on the share of domestic sales is not significant. For undervaluation, it positively and significantly impacts the share of exports (column 4) while it has no significant impact on the share of domestic sales (column 5). An undervaluation of 1% leads to an increase in the share of exports by 0.540 percentage points. Table 3.9 indicates that the poor quality of electricity service discourages manufacturing firms from selling their products abroad while the undervaluation encourages them to export more. However, the positive effect of undervaluation is apparently offset by the negative impact of power outages. Indeed, the effect of power outages on the share of exports (-0.939 percentage points) is approximately two times higher than that of exchange rate undervaluation (0.540 percentage points).

Table 3.10 presents the collateral damage effects of power outages and exchange rate undervaluation. The OLS method states that neither power outages nor undervaluation have a statistically significant effect on the purchase of foreign and domestic inputs (columns 1 & 2). To address the endogeneity bias, the IVFE method is applied in columns 3-6. As earlier, the instruments remain valid in the first stages of the estimate (columns 3 & 5). The length of power outages and exchange rate undervaluation negatively affect the share of foreign inputs and positively impact the share of domestic inputs in the total purchase of inputs. A 1% increase in power outages and exchange rate undervaluation reduces the share of foreign inputs by 0.793 and 0.357 percentage points, respectively (column 3) while it increases the share of domestic inputs by 0.638 and 0.332 percentage points, respectively. In addition to being unable to eliminate the negative effects of power outages, undervaluation is a barrier to foreign inputs utilization. As these inputs are an important source of productivity for manufacturing firms, their reduction due to undervaluation could lead, in the long run, to significant productivity losses and thus competitiveness losses. Since these competitiveness losses are due to productivity losses, they could be greater than the competitiveness gain from undervaluation, which is due to a simple price reduction. To summarize, the drop in input imports would negatively affect the production structure of firms, whereas the drop in prices would be temporary.

The above results highlight three interesting findings. First, power outages in SSA represent an obstacle to the movement of manufacturing firms from the domestic to the export market. Since manufacturing exports allow for the improvement of living standards through the creation of better jobs and the payment of better wages, improving the quality of electricity service becomes crucial for the development of SSA countries. Second, the undervaluation of real exchange rate seems to act as an instrument for promoting manufacturing exports thus as a source of the intra-sectoral structural change. Nevertheless, exchange rate undervaluation is unable to completely eliminate the negative effects of electricity shortages. Third, undervaluation also has a collateral damage as it reduces the imports of inputs which are an important source of productivity, therefore, an important source of competitiveness for manufacturing firms.

3.7 Sensitivity tests

The section examines four sensitivity tests related to access to electricity, innovation, business use of generators, and natural resource availability.

3.7.1 Countries with poor access to electricity vs countries with better access to electricity

The role of exchange rate undervaluation is to make firms more competitive by reducing or eliminating barriers/constraints related to their activities. Hence, if these obstacles - poor quality of electricity services - are less deep, the undervaluation of exchange rate could fail to achieve this goal. According to Freund et al. (2012), exchange rate depreciation allows to alleviate the distortions experienced by firms. The authors argue that exchange rate depreciation would be effective in developing countries with high distortions contrary to developed countries. This hypothesis is tested by applying the estimates to both the sample of countries with better access to electricity per capita and the sample of countries with poor access to electricity per population. The sample of countries with better access to electricity is made up of the 50% of countries with a high value of the variable: access to electricity by population. Likewise, the sample of countries with poor access to electricity is made up of the 50% of countries with a low value of the same variable. Obviously, the effects of undervaluation and power outages should be more important and statistically significant in countries with poor access to electricity than countries with better access to electricity. Table 3.11 reports the results of the present sensitivity test. Indeed, an undervaluation of 1% increases the share of exports by 1.311 percentage points (column 2) and reduces that of domestic sales by 0.513 percentage points in countries with poor access to electricity (column 3). In countries with better access to electricity, a 1% undervaluation increases the share of exports by 0.312 percentage points (column 6) and reduces the share of domestic sales by 0.398 percentage points (column 8). For electricity shortages, a 1% increase in the length of power outages reduces the share of exports by 1.664 percentage points (column 2) while it raises the share of domestic sales by 1.186 percentage points (column 4) in countries with poor access to electricity. However, an augmentation of the length of power outages by 1% reduces the share of exports by 0.453 percentage points (column 6) while it increases the share of domestic sales by 0.311 percentage points (column 8) in countries with better access to electricity. From the previous sensitivity test, it appears that the effects of power outages and the undervaluation on the share of exports are three times higher in countries with poor access to electricity than countries with better access to electricity.

3.7.2 Innovative firms vs non-innovative firms

According to Van Beveren & Vandenbussche (2010), innovation increases the probability for firms to be exporters. Hence, there could be a correlation between innovation and the share of exports and that of domestic sales. If I define innovation as the introduction of new production processes, it can play a role in reducing the effect of power outages if the new technique leads to productivity and competitiveness gains. So, the negative impact of power outages on the share of exports should be lower and less significant in innovative firms compared to non-innovative firms. From the WBES, I define innovation as all firms that claim to introduce a new process of production. This definition highlights the fact that some firms are making efforts to introduce new production processes that could generate productivity gains and therefore competitive gains. For this category of firms, one might expect undervaluation to play a minor or insignificant role in increasing competitiveness. In contrast, firms that do not make these efforts may benefit from the competitive gains of undervaluation. To some extent, non-innovative firms could use the competitiveness gain due to undervaluation as a substitute for innovation. Hence, undervaluation would appear to be a double-edged sword.

Table 3.12 reports this sensitivity test and shows that an augmentation of power outages by 1% reduces the share of exports by 0.587 percentage points in innovative firms (column 2) while this effect is -1.455 percentage points in non-innovative firms (column 5). Table 3.12 also indicates that exchange rate undervaluation has a positive impact on the export share of non-innovative firms, whereas this effect is not significant for innovative firms. An undervaluation of 1% increases the export share by 0.779 percentage points in non-innovative firms (column 5). The previous results show that the obstacles like power outages affect more non-innovative firms than innovative firms. They also exhibits that undervaluation would be an effective subsidy to enhance exports of non-innovative firms by eliminating internal distortions in these enterprises contrary to innovative firms. Therefore, undervaluation, as an export promotion tool, appears to be ineffective in the case of firms that make efforts to innovate.

3.7.3 The share of self-generation in firms

Faced with power outages, an alternative solution that manufacturing firms often apply is self-generation of electricity. It allows to replace partially or totally the electricity coming from the public networks. According to Fisher-Vanden et al. (2015), in the long term, companies produce their own electricity by adopting a generator. In the specific case of Nigeria, 20-30% of firms' initial investment is allocated to improve the electricity supply's reliability. Thus, one could argue that the more a firm makes self-generation the less it will be affected by power outages therefore, it will experience little loss of productivity and competitiveness. As in the case of firms that innovate, one might expect undervaluation to play a minor or insignificant role in increasing competitiveness of firms that make efforts to remedy power outages through their own means. Firms that do little or no self-generation could also use undervaluation as a way to protect themselves from competitiveness losses due to power outages without investing in improving the quality of electricity service which should protect them against productivity losses due to power outages. I measure self-generation by the share of electricity that comes from a generator. In the overall sample, on average, the share of firms' electricity that comes from a generator is 60% (in country level). Thus, firms in which this share is less than 30% are considered to be more dependent on public electricity than those in which this share is greater than 30%.

Table 3.13 reports the results for the sample of firms that rely heavily on public electricity and for the sample of firms that rely on it less. In the sample of firms with small self-generation, a 1% increase in power outages leads to a 1.664 percentage points decrease in the share of exports (column 2) and a 1.186 percentage points rise in the share of domestic sales (column 4). However, the reduction in the export share caused by a 1% increase in power outages is 0.453 percentage points (column 6) while the increase in domestic sales is 0.311 percentage points (column 8) in the sample of firms with high self-generation. Regarding real exchange rate, an undervaluation of 1% leads to an increase in the share of exports by 1.311 percentage points (column 2) and a decrease in the share of domestic sales by 0.513 percentage points (column 4) in the sample of firms with little self-generation. For firms that rely heavily on self-generation, an undervaluation of 1% implies an increase in the export share of 0.312 percentage points (column 6) and a decrease in the domestic sales share of 0.398 percentage points (column 8). As mentioned earlier, the above results show that firms that make efforts to reduce power outages by important self-generation are less affected by electricity shortages and exchange rate undervaluation than those that do not make such efforts.

3.7.4 Excluding resources-rich countries

According to the model of Corden (1984), the main characteristic of the Dutch disease phenomenon is exchange rate appreciation. In such a context, an undervaluation may fail to rise the competitiveness of manufacturing firms. I expect that the undervaluation should be more significant with high elasticities in non-resources-rich countries contrary to resource-rich countries. Furthermore, in resource-rich countries, the industrial base being weak, a depreciation or undervaluation of the exchange rate would act more as a policy to promote exports of raw materials in contrast to non-resource-rich countries. Following the criteria of the World Bank, I consider as resource-rich all countries whose rents from the exploitation of natural resources are higher than 10% of GDP.

Table 3.14 sets out the results of the estimates in the sample of resource-rich and non-resource-rich countries. For non-resource-rich countries, an undervaluation of 1% increases the export share by 0.705 percentage points (column 2) while this impact is 0.480 percentage points in resource-rich countries (column 6). The negative effect of power outages on the export share is statistically significant in non-resource-rich countries while it is not in resource-rich ones. This could be explained by the fact that non-resource-rich countries would be much more dependent on manufacturing exports than resource-rich economies. It is important to note that in non resources-rich countries, the coefficients of undervaluation are approximately the same to those of power outages (-0.702 for exports share and 0.365 for the share of domestic sales). Thus, the undervaluation of exchange rate would allow to offset the negative impact of power outages on the share of exports in non resources-rich countries.

3.8 Robustness check

The present robustness check examines the effects of alternative measures of electricity service quality and exchange rate on the dependent variables. I use a macroeconomic measure of the electricity service quality, which is the percentage of the population that has access to electricity and its interaction with real exchange rate variables. The OLS method with country and industry fixed effects is applied with the lag of the electricity access variable. The purpose of this second estimation technique is to ensure that the results of the IVFE method are valid even when using other measure of electricity service quality and correcting for endogeneity bias by another method. The estimation also allows to study the effects of interactions between the access to electricity and exchange rate variables. The interaction variables will allow to understand the extent to which the effects of the exchange rate undervaluation and depreciation are affected by those of electricity shortages. The model is written as follows:

$$Y_{fict} = a + bA_{ct-1} + cE_{ct-1} + dF_{fict} + eX_{ct} + \delta_c + \theta i + \epsilon_{fict} \tag{3.8}$$

With A_{ct-1}, the lag (1) of the percentage of the population that has access to electricity.

Table 3.15 presents the results when the measure of electricity access (lag 1) and those of real exchange rate (lag 1) are the variables of interest as well as their interactions. The effects of electricity access and undervaluation as well as their interaction are reported in columns 1-4, those of electricity access and exchange rate depreciation are in columns 5-8 with their interaction. For the same dependent variable, the first column corresponds to the model without the interacting variable while the second column takes it into account. In column 1, a 1 percentage point increase in the proportion of the population with access to electricity increases the export share by 0.582 percentage points, while the effect of undervaluation is not significant. When controlling for the interaction variable, the impact of electricity access increases and the effect of undervaluation becomes significant (column 2). Furthermore, the interaction variable negatively affects the exports share, showing a substitutability between the improvement of the electricity service quality and undervaluation. In column 2, a 1 percentage point improvement in the electricity access per population reduces the impact of undervaluation on the share of exports by 0.17 percentage points. Columns 3 and 4 correspond to the models in which the share of domestic sales in total sales is the dependent variable, the same conclusions as above can be drawn but in the opposite direction. In column 5, the access to electricity positively impacts the exports share while the effect of exchange rate depreciation is not significant. Controlling for the interaction variable, the impact of electricity access increases drastically, the effect of exchange rate depreciation becomes statistically significant. As before, the effect of the interaction variable is negative; an increase in the proportion of people with access to electricity of 1 percentage point leads to a decrease in the effect of exchange rate depreciation of 0.583 percentage points on the share of exports. The same conclusions can be drawn in the last two columns, but in the opposite direction.

From the above findings, it appears that when a country improves its access to electricity, the positive effect of undervaluation decreases. Undervaluation is therefore an effective subsidy for manufacturing firms in the case of countries with low access to electricity. Countries with better access to electricity have less need for exchange rate undervaluation as a source of competitiveness to increase their export share. So, what really matters is to improve access to electricity rather than undervalue the real exchange rate. Therefore, exchange rate and electricity access policies are substitutes.

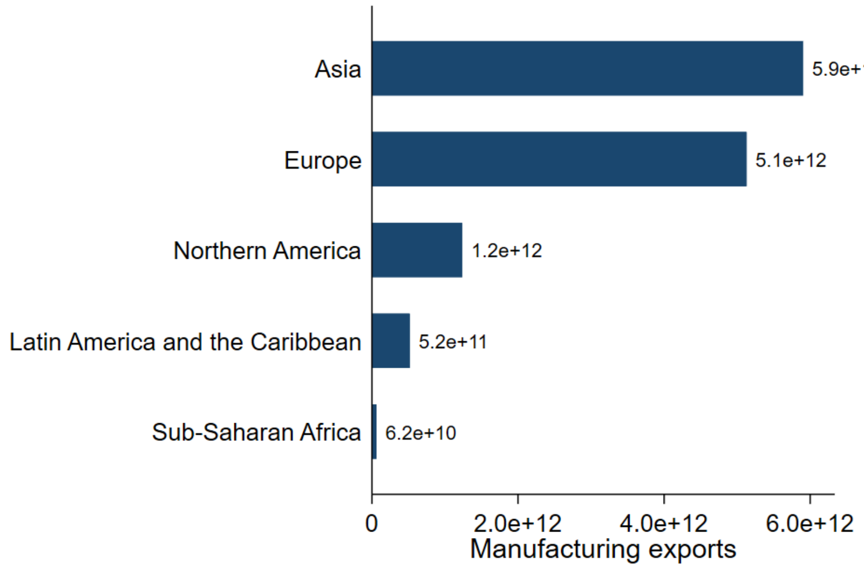
3.9 Concluding remarks

The movement of manufacturing firms from the domestic to the export market is seen as a way to improve the standard of living. Indeed, exporting firms appear to create better jobs and pay better wages than non-exporting firms. In the same vein, a number of studies advocate real exchange rate undervaluation policies as a means to promote manufacturing exports. Meanwhile, manufacturing firms in sub-Saharan Africa report that the poor quality of electricity service is the most important obstacle to their operations. From the above, a number of questions arise. How do exchange rate undervaluation and power outages affect the movement of firms into the export market? Are there interactions between the effects of these two variables? These are the questions that the paper aims to answer. More specifically, I study the allocation of 12,062 manufacturing firms between the domestic and exports markets in 33 sub-Saharan African countries. The effects of power outages and exchange rate undervaluation are examined on the share of exports and that of domestic sales in total sales.

The results on the overall sample suggest that power outages negatively affect the share of exports in total sales while the impact on the share of domestic sales is not significant. More specifically, a 1% increase in the length of power outages reduces the share of exports by 0.939 percentage points. For exchange rate undervaluation, it positively impacts the share of exports while its effect on the share of domestic sales is not significant. An undervaluation of 1% leads to an increase in the share of exports by 0.540 percentage points. The results on the overall sample show that the poor quality of electricity service discourages manufacturing firms from selling their products abroad while the undervaluation encourages them to export more. However, the positive effect of undervaluation is apparently offset by the negative effect of power outages. Indeed, the effect of power outages on the share of exports (-0.939) is approximately two times higher than that of exchange rate undervaluation (0.540). The collateral damage effects show a negative impact of power outages and undervaluation on the share of foreign inputs and a positive effect on the share of domestic input in the total purchase of inputs. A 1% increase in power outages and exchange rate undervaluation reduces the share of foreign inputs by 0.793 and 0.357 percentage points, respectively while it increases the share of domestic inputs by 0.638 and 0.332 percentage points, respectively. In addition to being unable to eliminate the negative effects of power outages, undervaluation is a barrier to foreign inputs utilization. The effect of power outages and that of undervaluation increase drastically in countries with poor access to electricity compared to those with better access to electricity. In addition, electricity shortages and undervaluation have a greater effect on non-innovative firms than innovative firms. For firms that rely heavily on self-generation, the effects of power outages and undervaluation are small compared to firms that do less self-generation. These results show that firms making efforts to introduce new production processes that could generate productivity gains and therefore competitive gains are less affected by power outages. Also, firms that make efforts to reduce electricity shortages by producing a part of their electricity consumption are less affected by power outages and exchange rate undervaluation than those that do not make such efforts. Furthermore, manufacturing companies in non-resource-rich countries are more affected by power outages and undervaluation than those in resource-rich countries. The macroeconomic measure of electricity service quality confirms the previous results. Indeed, a 1% increase in the proportion of the population that has access to electricity increases the share of exports by 0.582 percentage points. Considering the interaction variable, a 1% improvement in electricity access per population reduces the impact of exchange rate undervaluation and depreciation on the share of exports by 0.172 and 0.583 percentage points, respectively. From the above results, it appears that when a country improves its access to electricity, the positive effect of undervaluation decreases. Undervaluation is therefore an effective subsidy for manufacturing firms only in the case of countries with low access to electricity. Countries with better access to electricity have less need for exchange rate undervaluation as a source of competitiveness to increase their export share. So, what really matters is improving the access to electricity rather than undervaluing the real exchange rate. Hence, the exchange rate policy and policies improving electricity access are substitutes.

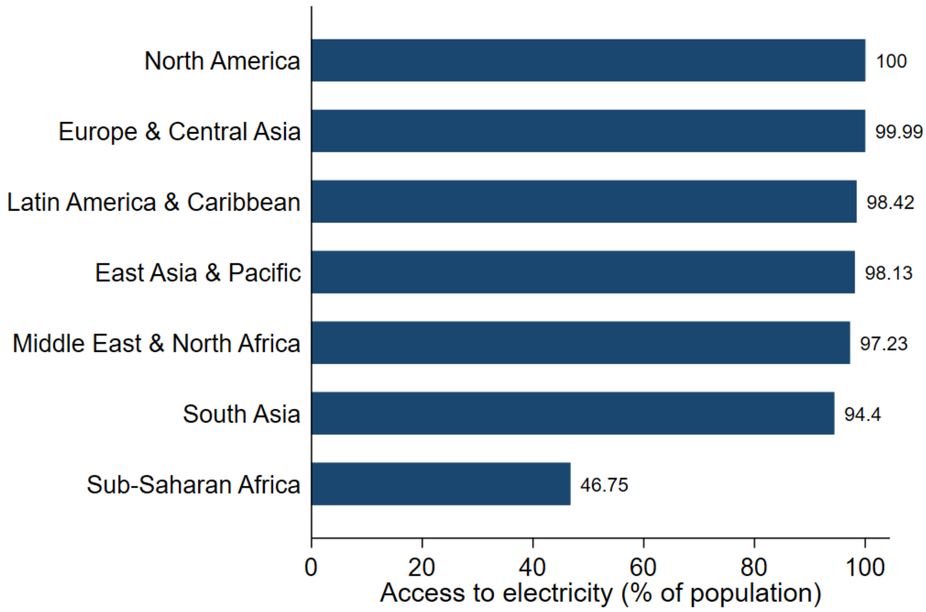
In summary, I find that the issue of electricity infrastructure must be considered in the exports promotion policies for manufacturing firms in sub-Saharan Africa. Since the effect of exchange rate undervaluation is important for firms in countries with poor access to electricity, non-innovative firms, less self-generation firms, and for firms in non-resources rich countries, it could be recommended for them. Nevertheless, it is important to note that undervaluation can be a double-edged sword for the aforementioned companies as it can discourage them from making innovation and self-generation efforts. Overall, the priority in sub-Saharan African countries should be the improvement of electricity infrastructure rather than exchange rate undervaluation. Indeed, undervaluation is a short-term solution because of the exchange rate competition that it could fuel. Also, given its collateral damage effects and its difficulty to be maintained in the long term, it can be substituted by policies improving the quality of electricity service, which is a more sustainable solution for firms' performance.

Figure 3.1: Manufacturing exports by United Nations Conference on Trade and Development regions classification



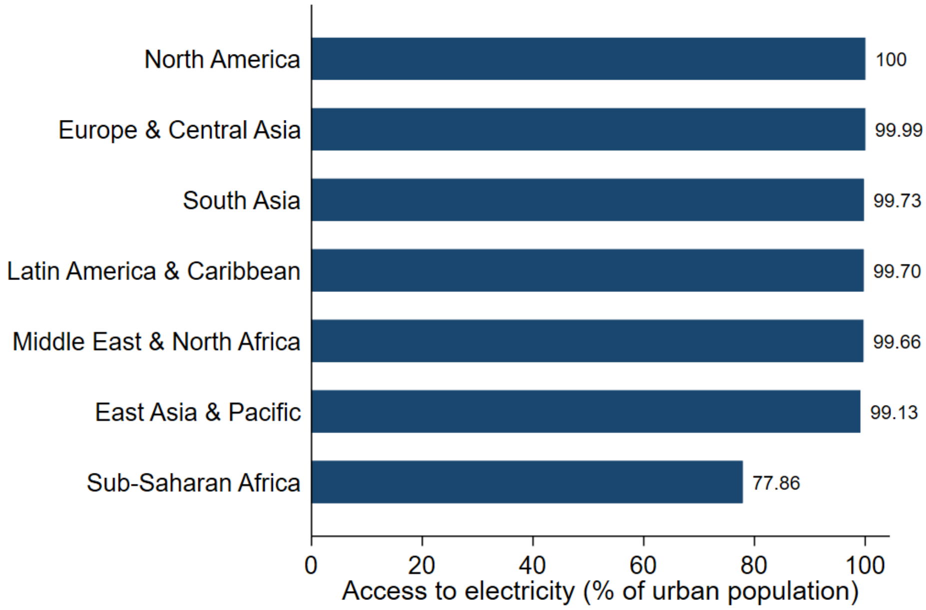
Author's construction. Source: UNCTAD.

Figure 3.2: Access to electricity (% of population) by World Bank regions classification



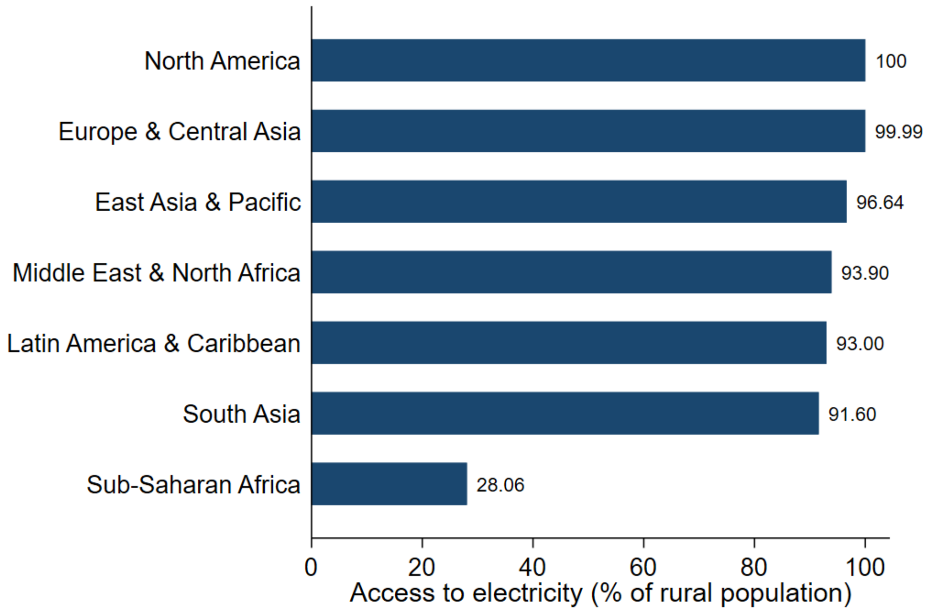
Author's construction. Source: World Development Indicators.

Figure 3.3: Access to electricity (% of urban population) by World Bank regions classification



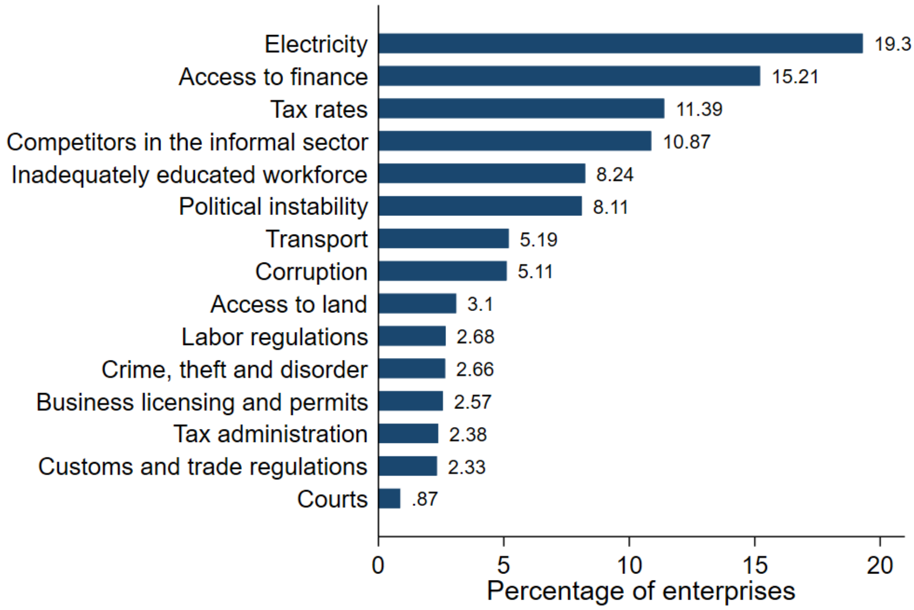
Author's construction. Source: World Development Indicators.

Figure 3.4: Access to electricity (% of rural population) by World Bank regions classification



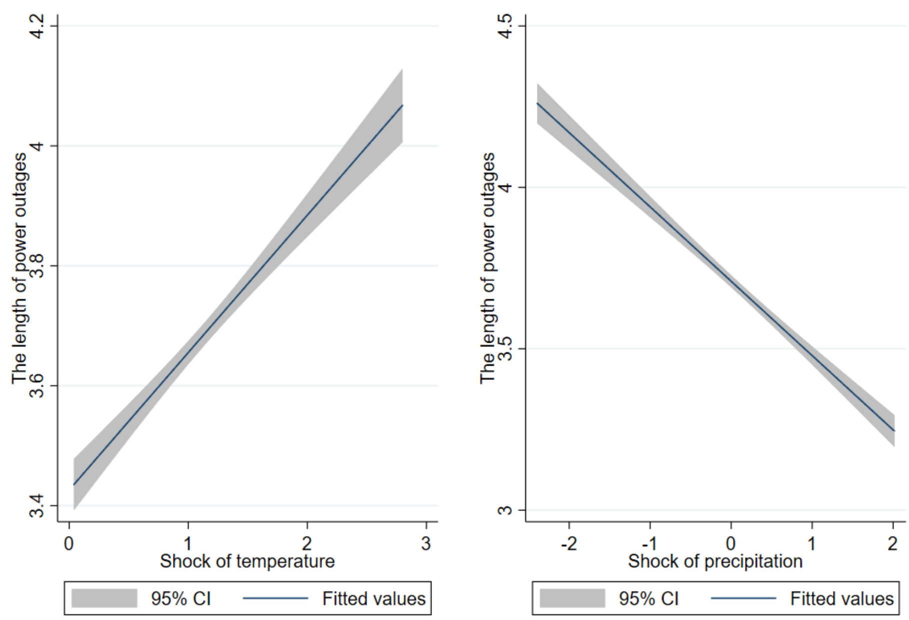
Author's construction. Source: World Development Indicators.

Figure 3.5: Biggest obstacle affecting the operations of firms



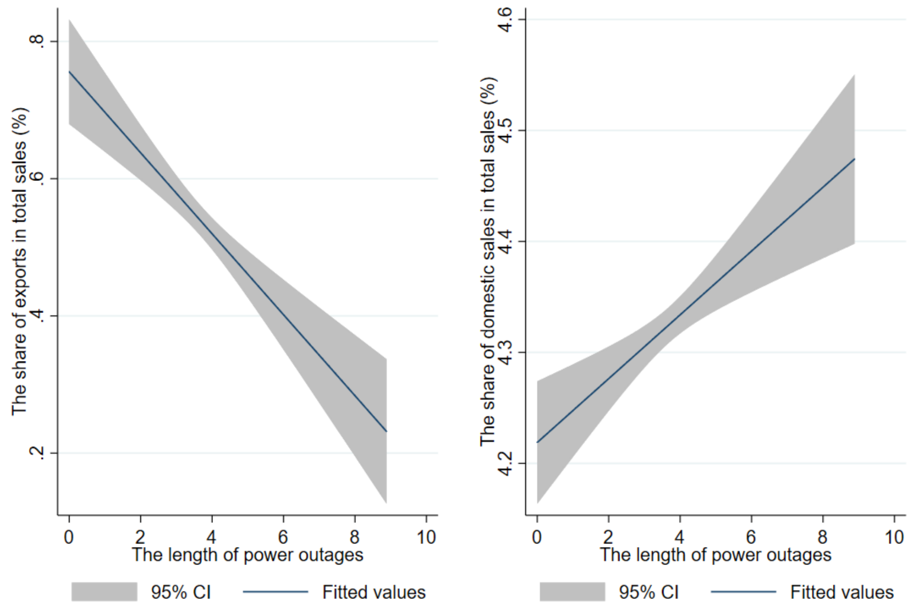
Author's construction. Source: World Bank Enterprise Surveys.

Figure 3.6: Correlation between the shocks of temperature/precipitation and the length of power outages in sub-saharan African manufacturing firms



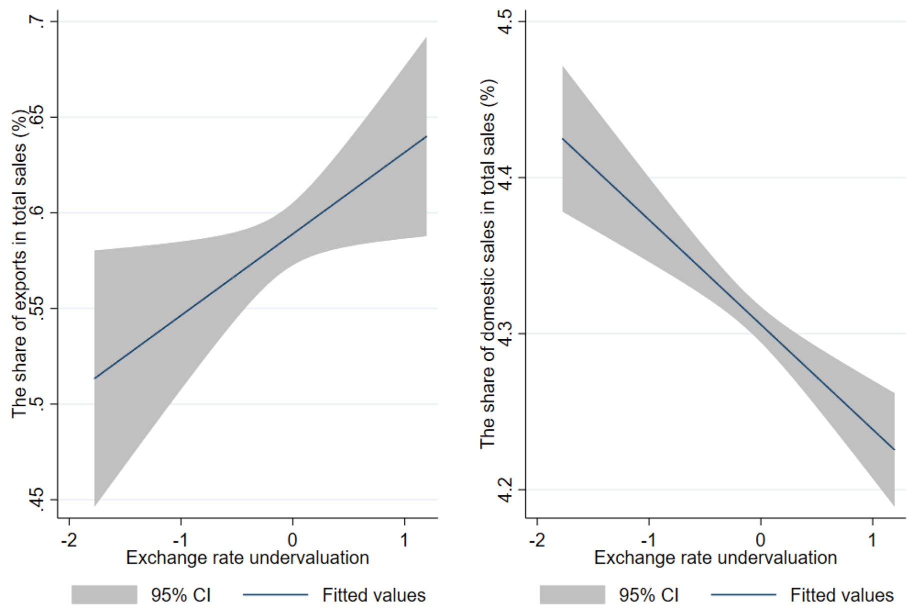
Author's construction. Source: World Bank Enterprise Surveys.

Figure 3.7: Correlation between the length of power outages and the allocation of manufacturing firms between the exports and the domestic market



Author's construction. Source: World Bank Enterprise Surveys.

Figure 3.8: Correlation between the exchange rate undervaluation and the allocation of manufacturing firms between the exports and the domestic market



Author's construction. Source: World Bank Enterprise Surveys.

Figure 3.9: Correlation between the length of power outages and the allocation of manufacturing firms between the imports and the domestic market

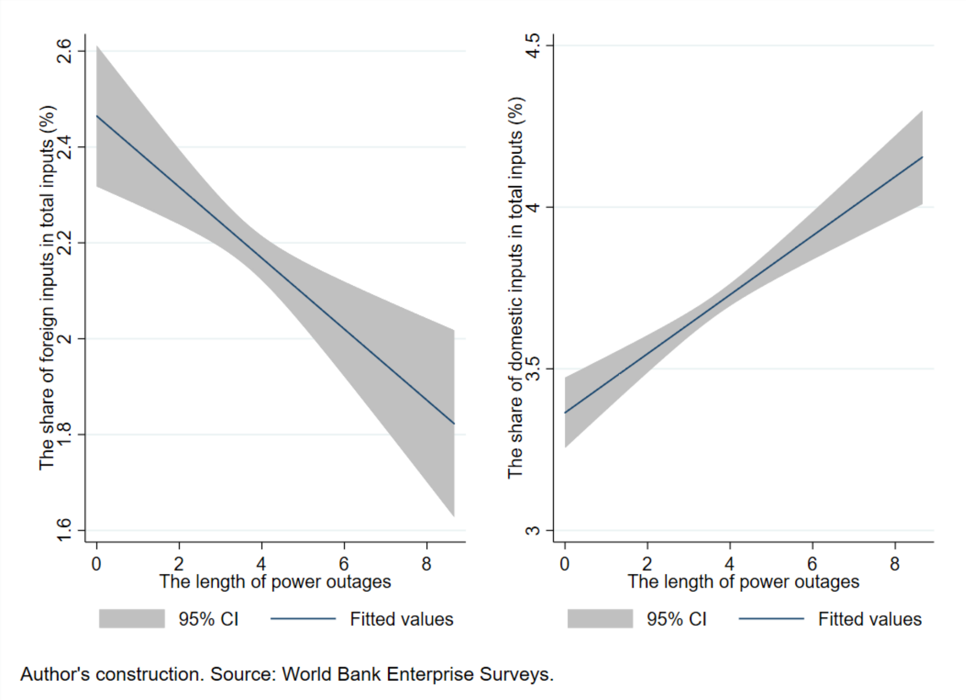


Figure 3.10: The performance of exporters and non-exporters

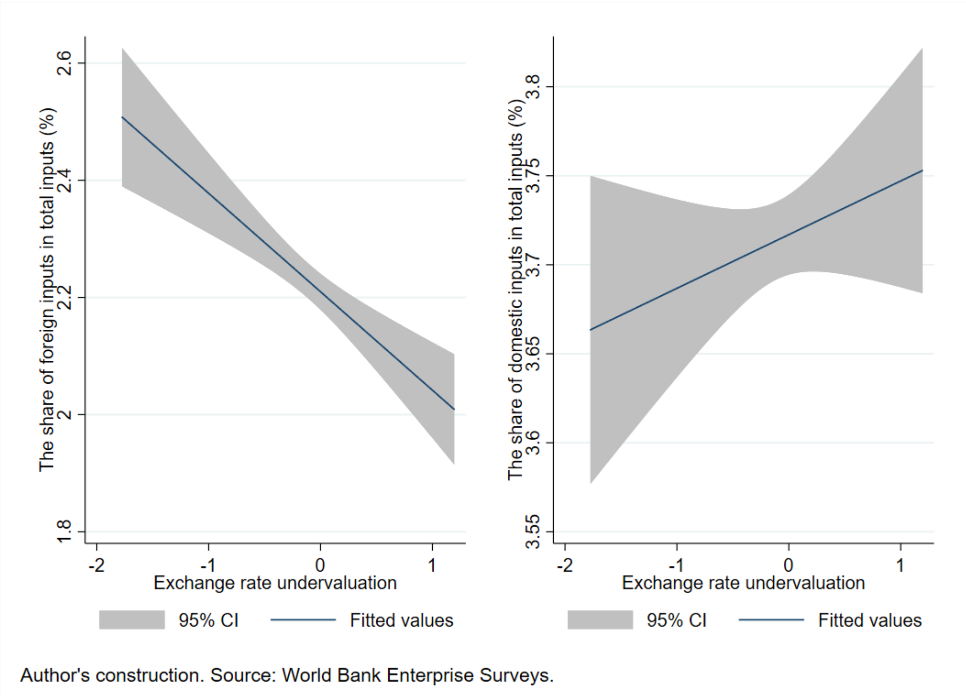


Table 3.1: The performance of exporters and non-exporters

Performance	Exporters	Non-exporters
Total sales	3.85e+07	4855553
Total employment	248.433	60.617
Number of Production workers	208.845	44.771
Number of Non-Production workers	44.228	14.110
Number of skilled workers	151.874	28.907
Number of unskilled workers	65.543	13.594
Number of female workers	35.13	10.87
Number of workers that the company would like to hire	47.11	5.47

Table 3.2: Number of firms and the share of each industry in the total sample of its sector

Industries	ISIC Code	Number of firms	Percent
Manufacturing sector		12062	100.00
Manufacture of food products and beverages	15	2,957	24.52
Manufacture of tobacco products	16	40	0.33
Manufacture of textiles	17	625	5.18
Manufacture of wearing apparel;	18	1,656	13.73
Tanning and dressing of leather	19	195	1.62
Manufacture of wood	20	524	4.34
Manufacture of paper and paper products	21	151	1.25
Publishing, printing and reproduction of recorded media	22	538	4.46
Manufacture of coke, refined petroleum products	23	31	0.26
Manufacture of chemicals and chemical products	24	630	5.22
Manufacture of rubber and plastics products	25	513	4.25
Manufacture of basic metals	26	1,015	8.41
Manufacture of other non-metallic mineral products	27	231	1.92
Manufacture of fabricated metal products	28	1,074	8.90
Manufacture of machinery and equipment n.e.c.	29	539	4.47
Manufacture of office, accounting and computing machinery	30	8	0.07
Manufacture of electrical machinery and apparatus n.e.c.	31	239	1.98
Manufacture of radio, television and communication equipment	32	40	0.33
Manufacture of medical, precision and optical instruments	33	66	0.55
Manufacture of motor vehicles, trailers and semi-trailers	34	97	0.80
Manufacture of other transport equipment	35	45	0.37
Manufacture of furniture; manufacturing n.e.c	36	817	6.77
Recycling	37	31	0.26
Non-manufacturing sector		9936	100.00
Other Industries	4	243	2.45
Mining and quarrying	10	2	0.02
Collection, purification and distribution of water	40	3	0.03
Construction	45	1,221	12.29
Wholesale and retail trade	50	6,255	62.95
Hotels and restaurants	55	1,179	11.87
Transport, storage and communications	60	766	7.71
Real estate, renting and business activities	70	265	2.67
Health	85	1	0.01
Other community, social and personal service activities	90	1	0.01

Table 3.3: Number of manufacturing firms and share of each country in the total sample

Countries	Number of firms	Percent
Angola	681	2.76
Benin	269	1.09
Botswana	573	2.32
Burkina Faso	362	1.46
Burundi	366	1.48
Cameroon	698	2.82
Chad	284	1.15
Ethiopia	1,265	5.12
Gabon	138	0.56
Ghana	1,106	4.47
Guinea	364	1.47
Guinea-Bissau	156	0.63
Kenya	2,22	8.98
Lesotho	242	0.98
Liberia	257	1.04
Madagascar	779	3.15
Malawi	470	1.90
Mali	824	3.33
Mauritania	317	1.28
Mauritius	283	1.14
Mozambique	838	3.39
Namibia	863	3.49
Niger	272	1.10
Nigeria	4,198	16.98
Rwanda	734	2.97
Senegal	929	3.76
Sierra Leone	279	1.13
South Africa	729	2.95
Sudan	273	1.10
Togo	230	0.93
Uganda	1,199	4.85
Zambia	1,566	6.34
Zimbabwe	953	3.86

Table 3.4: Descriptive statistics of the main variables

	Firms variables				
	Mean.	Std. Dev.	Min	Max	Observation
The share of sales directly exported	12.17	27.30	0.00	100.00	13700
The share of sales domestically sold	81.27	33.46	-9.00	100.00	13950
Inputs imports	31.26	36.60	0.00	100.00	13008
Domestic inputs	68.74	36.60	0.00	100.00	13009
The length of power outages	82.90	198.31	0.00	5760.20	6819
The number of power outages	80.49	371.72	0.00	24000.00	13955
Domestic private share	88.05	29.81	0.00	100.00	13718
Foreign private share	8.37	25.64	0.00	100.00	13701
Government share	1.03	7.90	0.00	100.00	13707
city_1	0.39	0.49	0.00	1.00	13955
Sales(t-3)	20139135.13	1.25e+09	0.00	1.47e+11	13955
Size					
Small (<20)	42%	0.49	0	1	5790
Medium (20-99)	35%	0.48	0	1	4888
Large (>99)	23%	0.42	0	1	3277
Sales (t-3)	2.77e+08	7.16e+09	0.00	5.90e+11	9313
	Macroeconomics variables				
Shock Temperature	1.01	0.53	0.04	2.46	13955
Shock Precipitation	0.23	0.85	-2.39	2.02	13955
Real exchange rate undervaluation (t-1)	-0.03	0.33	-0.83	2.30	13955
Access to electricity % population (t-1)	37.25	20.80	4.10	99.14	13817
Households consumption in GDP (%)	0.71	0.13	0.26	0.95	13955
Government consumption in GDP (Investment	22.20	6.83	9.11	42.79	12876
Trade openness	44.63	15.14	16.58	85.37	13955
GDP per capita growth	3.44	2.86	-4.17	15.00	13955
Growth	6.17	3.06	-1.62	18.33	13955
Rule of law	-0.66	0.53	-1.63	0.94	13955
N	13955				

Table 3.5: Summary of the dependent variables (percentage of total sales) by country

Country	Direct Exports	Indirect Exports	Domestic Sales	Exporters Dummy	Domestic Sellers Dummy
Angola2006	.023	.23	99.74	.00	1.00
Angola2010	0	.71	99.29	0	1
Burundi2013	21.88	5.73	72.38	.40	.58
Burundi2019	20.32	7.96	71.72	.39	.60
Botswana2009	26.89	6.32	66.79	.54	.44
Botswana2017	8.07	1.30	90.63	.18	.82
BurkinaFaso2007	24.55	4.55	70.91	.32	.64
BurkinaFaso2009	20.36	3.75	75.89	.39	.61
BurkinaFaso2013	10.35	9.35	80.30	.22	.74
Benin2013	30	0	70	.67	.33
Benin2018	21.19	6.42	72.38	.51	.49
Cameroon2006	.49	1.03	98.48	.02	.97
Cameroon2009	2.48	10.62	86.90	.1	.90
Cameroon2013	.	.	.	.	.
Cameroon2014	6.75	10.27	82.98	.18	.78
Chad2016	11.73	11.05	77.23	.13	.76
Ethiopia2006	25.70	1.30	73	.36	.64
Ethiopia2009	34.79	6.55	58.66	.58	.43
Ethiopia2011	10.50	2.30	87.20	.23	.77
Ethiopia2013	36.38	14.71	48.92	.63	.33
Ethiopia2016	8.13	6.58	85.30	.35	.65
Ethiopia2019	53.08	9.13	37.80	.84	.16
Gabon2011	1.72	4.74	93.53	.02	.97
Ghana2008	17.22	.88	81.89	.26	.74
Ghana2013	5.79	1.60	92.60	.13	.87
Ghana2018	2.73	2.58	94.70	.09	.91
Ghana2019	19.46	2.84	77.71	.30	.70
Guinea2006	10.24	4.489	85.28	.33	.66
Guinea-Bissau2006	9.90	3.59	86.51	.26	.74
Guinea-Bissau2010	10.19	4.60	85.21	.32	.67
Kenya2007	11.59	2.10	86.31	.37	.63
Kenya2013	12.18	11.96	75.86	.35	.57
Kenya2010	1.99	1.26	96.75	.08	.92
Lesotho2013	10	0	90	.67	.33
Lesotho2019	42	9.52	48.48	.66	.33
Liberia2013	21.14	3.82	75.05	.47	.53
Madagascar2009	30.51	5.46	64.03	.55	.44
Madagascar2013	29.21	6.62	64.17	.59	.41
Madagascar2016	14.17	2.22	83.61	.25	.75
Madagascar2017	3.41	1.88	94.71	.10	.88
Malawi2009	28.47	8.60	62.93	.33	.60
Malawi2013	9.33	8.92	81.75	.25	.67
Malawi2019	38.68	9.2	52.12	.63	.37
Mali2009	3.85	2	94.15	.15	.85
Mali2014	4.09	1.86	94.05	.17	.83
Mali2015	17.89	9.40	72.72	.48	.5
Mauritania2007	2.19	2.84	94.96	.07	.93
Mauritania2015	16.07	6.28	77.66	.45	.55
Mauritius2007	4.05	2.28	93.67	.09	.91
Mauritius2010	0	0	100	0 1	
Mozambique2013	22.52	6.24	71.25	.33	.66
Mozambique2019	19.67	10.18	70.15	.35	.64

Table 3.6: Summary of the dependent variables (percentage of total sales) by country

Country	Direct Exports	Indirect Exports	Domestic Sales	Exporters Dummy	Domestic Sellers Dummy
Namibia2014	16.31	2.71	80.98	.17	.81
Namibia2018	5.89	4.08	90.03	.15	.84
Nigeria2006	4.96	2.72	92.32	.12	.88
Nigeria2007	.63	.29	99.08	.02	.98
Nigeria2009	3.62	2.40	93.98	.20	.80
Nigeria2010	8.19	4.01	87.80	.17	.82
Nigeria2013	2.65	.10	97.24	.08	.92
Nigeria2014	6.91	9.09	84.27	.21	.77
Nigeria2016	8.86	6.09	85.05	.17	.79
Nigeria2017	.48	2.26	97.26	.06	.94
Rwanda2012	2.34	.92	96.75	.11	.89
Senegal2012	1.33	3.48	95.18	.12	.88
Senegal2019	2.16	5.33	92.51	.10	.90
Sierra Leone2007	4.49	.43	95.09	.15	.85
Sierra Leone2009	6.95	4.76	88.29	.29	.71
Sierra Leone2019	8.39	7.06	84.56	.33	.61
South Africa2009	30.93	3.79	65.28	.55	.45
South Africa2013	21.66	7.04	71.30	.53	.47
South Africa2017	1.04	1.39	97.57	.05	.95
South Africa2019	13.06	9.37	77.57	.31	.69
Togo2008	5.10	1.98	92.92	.1	.90
Togo2013	13.14	0	86.86	.14	.86
Uganda2008	18.56	8.88	72.56	.46	.53
Uganda2013	17.74	13.92	68.35	.43	.51
Zambia2009	22.25	8.46	69.33	.36	.60
Zambia2010	1.57	.12	98.31	.13	.87
Zambia2015	16.32	8.70	74.98	.25	.72
Zimbabwe2013	16.49	1.65	81.86	.34	.66
Zimbabwe2015	16.26	7.72	76.03	.27	.71
Zimbabwe2019	21.74	.56	77.69	.38	.62

Table 3.7: Summary of power outages and exchange rate variables by country

Country	Length of Outages	Number of Outages	Undervaluation
Angola2006	328.53	82.70	-.06
Angola2010	141.00	75.43	-.16
Burundi2013	26.90	18.31	-.26
Burundi2019	16.73	7.32	-.83
Botswana2009	42.32	34.76	.11
Botswana2017	24.40	13.40	.07
BurkinaFaso2007	20.73	12.55	.22
BurkinaFaso2009	16.73	18.14	.15
BurkinaFaso2013	34	7.83	-.24
Benin2013	.	0	-.05
Benin2018	40.39	3.42	.13
Cameroon2006	130.57	112.24	-.42
Cameroon2009	37.89	84	-.11
Cameroon2013	.	.	.
Cameroon2014	60.81	233.36	.20
Chad2016	17.14	36.22	-.12
Ethiopia2006	23.34	26.78	.83
Ethiopia2009	31.68	6.45	.31
Ethiopia2011	100.80	82.64	-.32
Ethiopia2013	18.24	6.17	.53
Ethiopia2016	55.16	39.60	-.12
Ethiopia2019	15.24	4.78	-.58
Gabon2011	60.91	76.34	-.18
Ghana2008	145.64	9.12	-.36
Ghana2013	39.82	12.11	-.13
Ghana2018	81.52	197.45	-.13
Ghana2019	48.00	30.73	-.12
Guinea2006	38.53	23.29	-.44
Guinea-Bissau2006	21.6	21.54	.35
Guinea-Bissau2010	34.71	26.95	-.14
Kenya2007	58.56	65.18	.18
Kenya2013	70.32	90.35	.31
Kenya2010	65.06	6.52	-.12
Lesotho2013	48	600	-.60
Lesotho2019	19.04	4.58	-.13
Liberia2013	66.30	742.79	-.36
Madagascar2009	34.29	6.73	-.29
Madagascar2013	25.85	10.48	.1
Madagascar2016	63.78	9.67	-.02
Madagascar2017	118.04	177.39	.15
Malawi2009	25.29	195.20	.91
Malawi2013	40	5	-.82
Malawi2019	58.17	6.60	.00
Mali2009	42	10.15	-.15
Mali2014	50.14	85.92	.02
Mali2015	168.37	3.81	.05
Mauritania2007	35.96	53.47	.25
Mauritania2015	166.43	6.79	-.08
Mauritius2007	53.04	59.43	-.10
Mauritius2010	204	146 68	.08
Mozambique2013	30.55	14.40	-.22
Mozambique2019	173.33	4.81	.48

Table 3.8: Summary of power outages and exchange rate variables by country (continued)

Country	Length of Outages	Number of Outages	Undervaluation
Namibia2014	28.67	151.22	.02
Namibia2018	73.71	17.92	.40
Nigeria2006	49.64	78.43	-.76
Nigeria2007	110.31	322.04	.00
Nigeria2009	19.59	295.68	-.05
Nigeria2010	51.62	75.79	-.10
Nigeria2013	48	118.78	.13
Nigeria2014	168.87	453.22	-.02
Nigeria2016	54.47	36.57	-.12
Nigeria2017	66.78	186.58	-.09
Rwanda2012	76.29	4.26	-.15
Senegal2012	36	3.27	.11
Senegal2019	22.30	3.58	.05
Sierra Leone2007	73.35	140.70	-.17
Sierra Leone2009	70	58.29	-.32
Sierra Leone2019	10.34	24	.30
South Africa2009	19.43	6.09	-.09
South Africa2013	23.57	9.29	-.16
South Africa2017	160.87	94.29	.28
South Africa2019	13.86	6.86	.14
Togo2008	140.86	57.68	2.30
Togo2013	52	89.14	-.22
Uganda2008	39.05	32.96	.14
Uganda2013	35.22	20.97	.36
Zambia2009	105.34	16.49	-.04
Zambia2010	28.17	27.18	-.11
Zambia2015	93.82	4.84	-.01
Zimbabwe2013	69.88	113.74	.15
Zimbabwe2015	242.43	4.93	.00
Zimbabwe2019	108.59	283.69	-.18

Table 3.9: The effects of power outages (length of outages) and real exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market

	Dependent variable: Share of sales exported and domestically sold by firms (log)					
	Linear fixed-effects model		Instrumental variables for panel-data models			
	Sales exported	Domestic sales	Sales exported		Domestic sales	
	(1)	(2)	(3)	(4)	(5)	(6)
	Model 1	Model 2	First Stage	Model 3	First Stage	Model 4
Length of power outages (log)	0.005	-0.015		-0.939***		0.165
	(0.018)	(0.014)		(0.203)		(0.135)
Undervaluation (log)	0.454***	-0.504***				
	(0.163)	(0.133)				
l.Undervaluation (log)			0.359***	0.540***	0.359***	-0.031
			(0.063)	(0.146)	(0.063)	(0.095)
Nationals share of capital (log)	-0.011	0.090***	-0.026	-0.035	-0.026	0.095***
	(0.028)	(0.020)	(0.018)	(0.033)	(0.018)	(0.021)
Foreign share of capital (log)	0.155***	-0.037**	-0.031*	0.128***	-0.031*	-0.033*
	(0.026)	(0.018)	(0.016)	(0.031)	(0.016)	(0.019)
Government of capital (log)	0.056	0.017	0.004	0.064	0.004	0.013
	(0.049)	(0.033)	(0.034)	(0.060)	(0.034)	(0.034)
Medium size	0.344***	-0.148***	0.011	0.349***	0.008	-0.153***
	(0.038)	(0.027)	(0.029)	(0.046)	(0.029)	(0.028)
Large size	1.255***	-0.706***	0.029	1.276***	0.026	-0.711***
	(0.063)	(0.050)	(0.040)	(0.074)	(0.040)	(0.051)
Location (= large city)	-0.175***	0.076**	0.024	-0.122*	0.026	0.048
	(0.050)	(0.037)	(0.037)	(0.063)	(0.037)	(0.039)
Households consumption share (log)	0.949***	-0.733***	-1.648***	-0.011	-1.657***	-0.613***
	(0.208)	(0.161)	(0.191)	(0.360)	(0.191)	(0.238)
Government consumption share (log)	-0.430**	0.293*	-0.903***	-1.401***	-0.909***	0.323
	(0.216)	(0.159)	(0.167)	(0.348)	(0.167)	(0.215)
Investment	-0.003	-0.004	-0.016**	-0.018*	-0.015**	0.001
	(0.006)	(0.004)	(0.006)	(0.009)	(0.006)	(0.006)
Sales 3 years ago (log)	0.030***	-0.004	-0.022***	0.011	-0.022***	-0.001
	(0.006)	(0.005)	(0.004)	(0.008)	(0.004)	(0.006)
Trade openness (log)	0.087	0.092	-0.590**	-0.881**	-0.591**	0.010
	(0.260)	(0.182)	(0.248)	(0.433)	(0.248)	(0.272)
GDP per capita growth	0.041	-0.078	-0.234	-0.178	-0.228	0.096
	(0.200)	(0.124)	(0.163)	(0.264)	(0.163)	(0.137)
GDP growth	-0.027	0.071	0.207	0.188	0.200	-0.099
	(0.197)	(0.123)	(0.160)	(0.260)	(0.160)	(0.135)
Rule of Law	-0.148	-0.400*	-0.120	-1.164***	-0.123	-0.149
	(0.257)	(0.212)	(0.279)	(0.414)	(0.279)	(0.282)
Instruments						
Shock Temperature			0.270***		0.271***	
			(0.050)		(0.050)	
Shock Precipitation			-0.254***		-0.251***	
			(0.048)		(0.047)	
Observation	6089.000	6085.000	6089.000	6089.000	6085.000	6085.000
F-stats	59.333	28.402		41.590		26.466
Kleibergen-Paap rk LM statistic				62.438		61.937
Chi-sq(2) P-value				0.000		0.000
Kleibergen-Paap rk Wald F statistic				32.205		31.935
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

Table 3.10: The effects of power outages (length of outages) and real exchange rate undervaluation on the purchase of foreign and domestic inputs

	Foreign Inputs	Domestic inputs	Foreign Inputs		Domestic inputs	
	(1)	(2)	(3)	(4)	(5)	(6)
	Model 1	Model 2	First Stage	Model 3	First Stage	Model 4
Length of power outages (log)	0.034	0.040**		-0.793***		0.638***
	(0.024)	(0.020)		(0.276)		(0.239)
Undervaluation (log)	0.003	0.124				
	(0.192)	(0.167)				
l.Undervaluation (log)			0.331***	-0.357**	0.332***	0.332**
			(0.063)	(0.178)	(0.063)	(0.156)
Nationals share of capital (log)	0.065**	0.054**	-0.023	0.043	-0.024	0.070**
	(0.030)	(0.026)	(0.019)	(0.035)	(0.019)	(0.028)
Foreign share of capital (log)	0.235***	-0.100***	-0.030*	0.207***	-0.030*	-0.079***
	(0.027)	(0.023)	(0.017)	(0.032)	(0.017)	(0.026)
Government of capital (log)	-0.073	0.162***	0.002	-0.069	0.002	0.160***
	(0.053)	(0.031)	(0.036)	(0.060)	(0.036)	(0.037)
Medium size	0.334***	-0.146***	-0.001	0.321***	-0.001	-0.134***
	(0.057)	(0.042)	(0.029)	(0.061)	(0.029)	(0.045)
Large size	0.963***	-0.321***	0.018	0.946***	0.018	-0.306***
	(0.074)	(0.057)	(0.041)	(0.081)	(0.041)	(0.062)
Location (= large city)	0.216***	-0.096*	0.023	0.252***	0.023	-0.117**
	(0.065)	(0.050)	(0.038)	(0.072)	(0.038)	(0.056)
Households consumption share (log)	1.971***	-0.639***	-1.732***	0.036	-1.729***	0.875**
	(0.307)	(0.229)	(0.195)	(0.513)	(0.195)	(0.419)
Government consumption share (log)	0.571*	-1.127***	-0.880***	-0.104	-0.880***	-0.619
	(0.327)	(0.296)	(0.174)	(0.447)	(0.174)	(0.393)
Investment	0.005	0.005	-0.018***	-0.038***	-0.017***	0.038***
	(0.010)	(0.007)	(0.006)	(0.012)	(0.006)	(0.010)
Sales 3 years ago (log)	0.014*	-0.005	-0.019***	0.004	-0.019***	0.002
	(0.008)	(0.007)	(0.005)	(0.010)	(0.005)	(0.008)
Trade openness (log)	-1.318***	0.108	-0.432*	-0.869*	-0.433*	-0.291
	(0.364)	(0.327)	(0.253)	(0.516)	(0.253)	(0.455)
GDP per capita growth	2.137***	-0.928***	-0.223	1.392***	-0.221	-0.353
	(0.285)	(0.242)	(0.167)	(0.335)	(0.167)	(0.290)
GDP growth	-2.023***	0.870***	0.193	-1.302***	0.192	0.313
	(0.280)	(0.237)	(0.163)	(0.329)	(0.163)	(0.284)
Rule of Law	-2.068***	1.114***	-0.060	-1.383***	-0.063	0.439
	(0.325)	(0.272)	(0.284)	(0.454)	(0.284)	(0.394)
Instruments						
Shock Temperature			0.272***		0.272***	
			(0.051)		(0.051)	
Shock Precipitation			-0.206***		-0.206***	
			(0.048)		(0.048)	
Observation	5794.000	5793.000	5794.000	5794.000	5793.000	5793.000
F-stats	48.375	20.824		41.919		20.494
Kleibergen-Paap rk LM statistic				51.211		51.053
Chi-sq(2) P-value				0.000		0.000
Kleibergen-Paap rk Wald F statistic				26.102		26.021
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

Table 3.11: The effects of power outages (length of outages) and real exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market: country with poor access to electricity vs country with better access to electricity

	Poor access to electricity				Better access to electricity			
	Sales exported		Domestic sales		Sales exported		Domestic sales	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	First Stage	Model 1	First Stage	Model 2	First Stage	Model 3	First Stage	Model 4
Length of power outages (log)		-1.664**		1.186**		-0.453***		0.311***
		(0.697)		(0.475)		(0.107)		(0.071)
l.Undervaluation (log)	0.031	1.311***	0.031	-0.513**	-0.060	0.312*	-0.060	-0.398***
	(0.178)	(0.400)	(0.178)	(0.254)	(0.145)	(0.173)	(0.145)	(0.117)
Nationals share of capital (log)	-0.012	0.003	-0.012	0.099**	-0.045**	-0.058	-0.046**	0.106***
	(0.028)	(0.062)	(0.028)	(0.044)	(0.022)	(0.037)	(0.022)	(0.030)
Foreign share of capital (log)	-0.011	0.123**	-0.011	-0.027	-0.052**	0.157***	-0.051**	-0.023
	(0.025)	(0.055)	(0.025)	(0.037)	(0.021)	(0.037)	(0.021)	(0.028)
Government share of capital (log)	0.001	-0.032	0.001	0.052	-0.028	0.107	-0.027	-0.014
	(0.047)	(0.107)	(0.047)	(0.073)	(0.049)	(0.071)	(0.049)	(0.056)
Medium size	0.036	0.535***	0.035	-0.228***	0.020	0.198***	0.016	-0.084**
	(0.044)	(0.100)	(0.044)	(0.069)	(0.039)	(0.048)	(0.038)	(0.037)
Large size	0.037	1.417***	0.037	-0.677***	0.051	1.045***	0.047	-0.743***
	(0.053)	(0.123)	(0.053)	(0.090)	(0.059)	(0.100)	(0.059)	(0.083)
Location (= large city)	0.056	-0.220	0.054	0.094	-0.003	-0.019	0.003	0.047
	(0.058)	(0.139)	(0.058)	(0.100)	(0.052)	(0.066)	(0.052)	(0.054)
Households consumption (log)	-0.563	3.479*	-0.576	-0.376	-3.221***	0.507	-3.220***	-0.867***
	(0.854)	(1.979)	(0.856)	(1.430)	(0.294)	(0.402)	(0.294)	(0.294)
Government consumption (log)	-0.296	-0.800	-0.302	1.135**	-1.924***	-0.924***	-1.919***	0.258
	(0.433)	(0.724)	(0.433)	(0.560)	(0.227)	(0.338)	(0.227)	(0.234)
Investment	0.016	0.102**	0.016	-0.015	-0.090***	0.011	-0.089***	-0.034***
	(0.022)	(0.041)	(0.022)	(0.028)	(0.013)	(0.014)	(0.013)	(0.011)
Sales 3 years ago (log)	-0.010	0.048***	-0.010	-0.009	-0.024***	0.007	-0.023***	0.008
	(0.007)	(0.016)	(0.007)	(0.011)	(0.006)	(0.008)	(0.006)	(0.007)
Trade openness (log)	-0.944*	-2.866**	-0.947*	0.512	1.157*	-1.462**	1.148*	1.904***
	(0.545)	(1.440)	(0.545)	(1.091)	(0.610)	(0.672)	(0.609)	(0.430)
GDP per capita growth	-0.135	0.699	-0.132	0.204	-0.914**	-2.037***	-0.917**	1.550***
	(0.256)	(0.556)	(0.256)	(0.349)	(0.460)	(0.621)	(0.460)	(0.462)
GDP growth	0.127	-0.545	0.123	-0.243	0.915**	2.059***	0.917**	-1.569***
	(0.253)	(0.543)	(0.253)	(0.347)	(0.450)	(0.609)	(0.450)	(0.451)
Rule of Law	-1.569**	-6.698***	-1.566**	2.182**	2.937***	-0.514	2.928***	0.956*
	(0.716)	(1.336)	(0.716)	(0.922)	(0.790)	(0.714)	(0.789)	(0.506)
Instruments								
Shock Temperature	0.294**		0.293**		0.929***		0.927***	
	(0.117)		(0.117)		(0.090)		(0.090)	
Shock Precipitation	-0.190		-0.190		-0.446***		-0.439***	
	(0.144)		(0.144)		(0.065)		(0.064)	
Observation	2728.000	2728.000	2725.000	2725.000	3344.000	3344.000	3343.000	3343.000
Kleibergen-Paap rk LM statistic		12.753		12.735		84.151		83.663
Chi-sq(2) P-value		0.002		0.002		0.000		0.000
Kleibergen-Paap rk Wald F statistic		6.767		6.756		68.038		67.530
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3.12: The effects of power outages (length of outages) and real exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market: Innovative firms vs non-innovative firms

	Dependent variable: Share of sales exported and domestically sold by firms (log)							
	Ordinary least square instrumental method with country and industry fixed effects							
	Innovative firms				Non-innovative firms			
	Sales exported		Domestic sales		Sales exported		Domestic sales	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	First Stage	Model 1	First Stage	Model 2	First Stage	Model 3	First Stage	Model 4
Length of power outages (log)		-0.587**		0.315*		-1.455***		0.240
		(0.283)		(0.181)		(0.380)		(0.217)
l.Undervaluation (log)	0.054	0.351	0.056	-0.230	0.330***	0.779***	0.327***	-0.011
	(0.200)	(0.345)	(0.200)	(0.249)	(0.084)	(0.232)	(0.084)	(0.128)
Nationals share of capital (log)	-0.040	-0.066	-0.040	0.137***	-0.002	-0.004	-0.002	0.074***
	(0.027)	(0.051)	(0.027)	(0.043)	(0.024)	(0.047)	(0.024)	(0.022)
Foreign share of capital (log)	-0.053**	0.122**	-0.052*	0.011	-0.007	0.142***	-0.007	-0.050***
	(0.026)	(0.052)	(0.027)	(0.040)	(0.020)	(0.042)	(0.021)	(0.019)
Government share of capital (log)	-0.004	0.243***	-0.004	-0.042	0.001	-0.057	0.001	0.048
	(0.042)	(0.087)	(0.042)	(0.064)	(0.048)	(0.088)	(0.048)	(0.042)
Medium size	0.082	0.439***	0.079	-0.057	-0.001	0.293***	-0.006	-0.171***
	(0.064)	(0.099)	(0.064)	(0.075)	(0.032)	(0.063)	(0.032)	(0.029)
Large size	0.089	1.236***	0.089	-0.582***	-0.009	1.201***	-0.013	-0.738***
	(0.080)	(0.134)	(0.080)	(0.105)	(0.046)	(0.100)	(0.046)	(0.058)
Location (= large city)	0.017	-0.110	0.016	0.266***	0.048	-0.054	0.052	-0.051
	(0.075)	(0.103)	(0.075)	(0.080)	(0.045)	(0.092)	(0.045)	(0.049)
Households consumption (log)	-1.516**	-1.931	-1.512**	-1.369	-1.766***	-1.090	-1.796***	-0.305
	(0.758)	(1.342)	(0.759)	(0.861)	(0.224)	(0.687)	(0.223)	(0.386)
Government consumption (log)	-2.908***	-2.074*	-2.902***	0.138	-0.733***	-1.658***	-0.739***	0.525**
	(0.524)	(1.182)	(0.524)	(0.754)	(0.186)	(0.479)	(0.186)	(0.248)
Investment	-0.116***	-0.036	-0.115***	-0.019	-0.009	-0.012	-0.009	-0.003
	(0.030)	(0.030)	(0.030)	(0.019)	(0.007)	(0.013)	(0.007)	(0.007)
Sales 3 years ago (log)	-0.032***	0.007	-0.032***	0.017	-0.015***	0.018	-0.014***	-0.006
	(0.009)	(0.017)	(0.009)	(0.012)	(0.005)	(0.011)	(0.005)	(0.006)
Trade openness (log)	0.538	-2.349**	0.537	0.661	-0.953***	-2.055***	-0.945***	0.355
	(0.670)	(0.912)	(0.671)	(0.498)	(0.296)	(0.753)	(0.295)	(0.440)
GDP per capita growth	-1.103	-3.607***	-1.096	1.406*	-0.103	-0.040	-0.094	0.082
	(1.026)	(1.337)	(1.026)	(0.793)	(0.179)	(0.340)	(0.179)	(0.139)
GDP growth	1.118	3.664***	1.111	-1.351*	0.086	0.063	0.076	-0.102
	(1.018)	(1.322)	(1.018)	(0.780)	(0.176)	(0.335)	(0.176)	(0.137)
Rule of Law	1.756**	-0.025	1.751**	0.608	-0.653*	-2.170***	-0.651*	-0.167
	(0.705)	(0.972)	(0.705)	(0.610)	(0.337)	(0.746)	(0.337)	(0.447)
Instruments								
Shock Temperature	0.778***		0.779***		0.224***		0.229***	
	(0.180)		(0.180)		(0.060)		(0.059)	
Shock Precipitation	-0.155		-0.157		-0.169***		-0.160***	
	(0.109)		(0.109)		(0.062)		(0.061)	
Observation	1476.000	1476.000	1473.000	1473.000	4610.000	4610.000	4609.000	4609.000
Kleibergen-Paap rk LM statistic		20.760		20.821		24.868		24.641
Chi-sq(2) P-value		0.000		0.000		0.000		0.000
Kleibergen-Paap rk Wald F statistic		11.442		11.481		12.723		12.591
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3.13: The effects of power outages (length of outages) and real exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market: Self-generation share

	Dependent variable: Share of sales exported and domestically sold by firms (log)							
	Ordinary least square instrumental method with country and industry fixed effects							
	Self-generation<=30%				Self-generation>30%			
	Sales exported		Domestic sales		Sales exported		Domestic sales	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	First Stage	Model 1	First Stage	Model 2	First Stage	Model 3	First Stage	Model 4
Length of power outages (log)		-1.422***		0.684***		-0.530***		0.146
		(0.395)		(0.257)		(0.140)		(0.093)
l.Undervaluation (log)	0.102	0.489**	0.104	-0.149	0.110	0.536**	0.110	-0.146
	(0.103)	(0.210)	(0.104)	(0.139)	(0.139)	(0.236)	(0.139)	(0.160)
Nationals share of capital (log)	-0.006	-0.028	-0.006	0.098***	-0.054**	-0.043	-0.055**	0.102***
	(0.024)	(0.049)	(0.024)	(0.029)	(0.022)	(0.049)	(0.022)	(0.038)
Foreign share of capital (log)	-0.005	0.111**	-0.005	-0.021	-0.075***	0.172***	-0.075***	-0.047
	(0.021)	(0.043)	(0.021)	(0.025)	(0.022)	(0.051)	(0.023)	(0.036)
Government share of capital (log)	0.001	-0.087	0.001	0.025	-0.010	0.359***	-0.007	0.012
	(0.040)	(0.083)	(0.040)	(0.055)	(0.066)	(0.082)	(0.065)	(0.042)
Medium size	0.093**	0.517***	0.092**	-0.240***	-0.094**	0.194***	-0.100**	-0.044
	(0.040)	(0.082)	(0.040)	(0.053)	(0.041)	(0.060)	(0.040)	(0.036)
Large size	0.059	1.417***	0.059	-0.751***	-0.007	0.930***	-0.010	-0.509***
	(0.049)	(0.104)	(0.049)	(0.071)	(0.066)	(0.134)	(0.066)	(0.091)
Location (= large city)	0.105**	0.028	0.104**	-0.026	-0.096	-0.358***	-0.082	0.239***
	(0.046)	(0.099)	(0.046)	(0.064)	(0.064)	(0.100)	(0.063)	(0.067)
Households consumption (log)	-0.495	-0.840	-0.500	1.603***	-2.544***	2.192***	-2.557***	-1.794***
	(0.472)	(0.947)	(0.472)	(0.608)	(0.350)	(0.618)	(0.350)	(0.435)
Government consumption (log)	-0.628**	-1.763***	-0.633**	0.874**	-1.855***	-2.107***	-1.840***	0.885**
	(0.260)	(0.602)	(0.261)	(0.383)	(0.313)	(0.507)	(0.312)	(0.373)
Investment	-0.015	-0.011	-0.015	-0.004	-0.035**	0.017	-0.034**	-0.008
	(0.009)	(0.016)	(0.009)	(0.010)	(0.016)	(0.018)	(0.016)	(0.012)
Sales 3 years ago (log)	-0.020***	0.019	-0.020***	0.004	-0.016***	0.004	-0.015***	0.003
	(0.006)	(0.014)	(0.006)	(0.009)	(0.006)	(0.010)	(0.006)	(0.006)
Trade openness (log)	-1.123***	-2.580***	-1.127***	0.505	1.555***	2.167***	1.526***	-1.015**
	(0.325)	(0.824)	(0.325)	(0.528)	(0.459)	(0.692)	(0.457)	(0.499)
GDP per capita growth	-0.347*	0.068	-0.344*	-0.143	-4.604***	-1.438	-4.568***	-1.449
	(0.192)	(0.378)	(0.192)	(0.212)	(0.564)	(1.490)	(0.564)	(1.159)
GDP growth	0.330*	-0.047	0.327*	0.138	4.439***	1.413	4.403***	1.385
	(0.188)	(0.374)	(0.189)	(0.211)	(0.549)	(1.446)	(0.548)	(1.125)
Rule of Law	-0.833***	-2.840***	-0.836***	0.493	1.644**	0.083	1.617**	-0.974*
	(0.310)	(0.733)	(0.310)	(0.507)	(0.718)	(0.898)	(0.717)	(0.591)
Instruments								
Shock Temperature	0.264***		0.262***		0.764***		0.761***	
	(0.074)		(0.075)		(0.094)		(0.093)	
Shock Precipitation	-0.150*		-0.151*		-0.590***		-0.586***	
	(0.088)		(0.088)		(0.071)		(0.071)	
Observation	3838.000	3838.000	3835.000	3835.000	2251.000	2251.000	2250.000	2250.000
Kleibergen-Paap rk LM statistic		23.421		23.223		84.395		83.961
Chi-sq(2) P-value		0.000		0.000		0.000		0.000
Kleibergen-Paap rk Wald F statistic		11.964		11.860		69.139		68.446
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3.14: The effects of power outages (length of outages) and real exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market: Resource-rich countries vs non-resource rich countries

	Dependent variable: Share of sales exported and domestically sold by firms (log)							
	Ordinary least square instrumental method with country and industry fixed effects							
	Non-resource-rich countries				Resource-rich countries			
	Sales exported		Domestic sales		Sales exported		Domestic sales	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	First Stage	Model 1	First Stage	Model 2	First Stage	Model 3	First Stage	Model 4
Length of power outages (log)		-0.705***		0.376**		-0.331		0.421**
		(0.242)		(0.162)		(0.229)		(0.185)
l.Undervaluation (log)	-0.370	0.702***	-0.370	-0.365**	-0.152	0.480**	-0.150	-0.366**
	(0.235)	(0.266)	(0.235)	(0.172)	(0.130)	(0.187)	(0.131)	(0.142)
Nationals share of capital (log)	-0.053*	-0.049	-0.053*	0.113***	-0.020	-0.027	-0.021	0.100***
	(0.030)	(0.050)	(0.030)	(0.035)	(0.021)	(0.035)	(0.021)	(0.029)
Foreign share of capital (log)	-0.053**	0.086*	-0.053**	0.007	-0.021	0.166***	-0.020	-0.055**
	(0.027)	(0.046)	(0.027)	(0.032)	(0.020)	(0.034)	(0.020)	(0.025)
Government of capital (log)	-0.059	-0.073	-0.059	-0.009	0.040	0.124*	0.042	0.048
	(0.046)	(0.081)	(0.046)	(0.067)	(0.048)	(0.065)	(0.048)	(0.036)
Medium size	0.101*	0.521***	0.101*	-0.216***	-0.039	0.236***	-0.045	-0.098***
	(0.052)	(0.075)	(0.052)	(0.053)	(0.034)	(0.049)	(0.034)	(0.036)
Large size	0.065	1.469***	0.065	-0.817***	-0.009	1.051***	-0.014	-0.589***
	(0.060)	(0.103)	(0.060)	(0.079)	(0.050)	(0.088)	(0.050)	(0.069)
Location (= large city)	0.090	-0.048	0.090	-0.016	0.053	-0.267***	0.058	0.163**
	(0.058)	(0.084)	(0.058)	(0.058)	(0.050)	(0.082)	(0.050)	(0.067)
Households consumption share (log)	-2.027*	0.617	-2.027*	-0.264	-2.311***	1.014**	-2.325***	-0.823**
	(1.129)	(1.729)	(1.129)	(1.183)	(0.325)	(0.457)	(0.324)	(0.367)
Government consumption share (log)	-1.584	-3.727***	-1.584	-0.167	-1.786***	-0.911*	-1.793***	1.180***
	(0.983)	(1.022)	(0.983)	(0.704)	(0.300)	(0.523)	(0.300)	(0.418)
Sales 3 years ago (log)	-0.022***	0.023*	-0.022***	0.005	-0.012**	0.025***	-0.011**	0.001
	(0.007)	(0.012)	(0.007)	(0.009)	(0.005)	(0.009)	(0.005)	(0.006)
Investment	-0.056***	0.023	-0.056***	-0.033*	-0.040***	-0.027*	-0.039***	0.002
	(0.017)	(0.025)	(0.017)	(0.017)	(0.013)	(0.014)	(0.013)	(0.010)
Trade openness (log)	0.263	-1.553**	0.263	0.438	-2.007***	1.081	-1.981***	0.042
	(0.434)	(0.620)	(0.434)	(0.319)	(0.388)	(0.833)	(0.388)	(0.705)
GDP per capita growth	-0.597	0.807	-0.597	0.522	-9.378***	0.286	-9.344***	1.579
	(0.558)	(0.638)	(0.558)	(0.393)	(1.352)	(2.029)	(1.353)	(1.534)
GDP growth	0.611	-0.750	0.611	-0.496	9.068***	-0.303	9.035***	-1.552
	(0.544)	(0.621)	(0.544)	(0.380)	(1.320)	(1.986)	(1.320)	(1.499)
Rule of Law	1.420**	-0.071	1.420**	0.037	2.565***	-1.836***	2.547***	0.604
	(0.605)	(0.609)	(0.605)	(0.390)	(0.655)	(0.575)	(0.656)	(0.470)
Instruments								
Shock Temperature	0.579***		0.579***		0.627***		0.628***	
	(0.112)		(0.112)		(0.088)		(0.088)	
Shock Precipitation	-0.243**		-0.243**		-0.002		-0.000	
	(0.116)		(0.116)		(0.096)		(0.096)	
Observation	2443.000	2443.000	2443.000	2443.000	3644.000	3644.000	3640.000	3640.000
F-stats		27.932		13.508		27.910		13.352
Kleibergen-Paap rk LM statistic		28.997		28.997		45.131		45.259
Chi-sq(2) P-value		0.000		0.000		0.000		0.000
Kleibergen-Paap rk Wald F statistic		16.380		16.380		26.445		26.543
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3.15: The effects of electricity access and real exchange rate undervaluation on the allocation of manufacturing firms between the export and domestic market

	Dependent variable: Share of sales exported and domestically sold by firms (log)							
	Ordinary least square with country and industry fixed effects							
	Sales exported		Domestic sales		Sales exported		Domestic sales	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
l.Electricity access (log)	0.582***	0.609***	-0.414***	-0.442***	0.567***	1.242***	-0.254**	-0.990***
	(0.137)	(0.137)	(0.106)	(0.106)	(0.151)	(0.370)	(0.117)	(0.282)
l.Exchange rate undervaluation (log)	0.058	0.647**	-0.040	-0.665***				
	(0.056)	(0.287)	(0.042)	(0.232)				
Nationals share of capital (log)	-0.005	-0.005	0.080***	0.080***	-0.005	-0.005	0.082***	0.082***
	(0.018)	(0.018)	(0.014)	(0.014)	(0.018)	(0.018)	(0.014)	(0.014)
Foreign share of capital (log)	0.181***	0.180***	-0.071***	-0.070***	0.181***	0.180***	-0.070***	-0.069***
	(0.017)	(0.017)	(0.012)	(0.012)	(0.017)	(0.017)	(0.012)	(0.012)
Government of capital (log)	0.075**	0.074**	0.020	0.021	0.075**	0.074**	0.022	0.022
	(0.034)	(0.034)	(0.020)	(0.020)	(0.034)	(0.034)	(0.020)	(0.020)
Medium size	0.411***	0.411***	-0.183***	-0.183***	0.411***	0.409***	-0.181***	-0.178***
	(0.027)	(0.027)	(0.020)	(0.020)	(0.027)	(0.027)	(0.020)	(0.020)
Large size	1.190***	1.189***	-0.615***	-0.614***	1.189***	1.185***	-0.610***	-0.606***
	(0.042)	(0.042)	(0.033)	(0.033)	(0.042)	(0.042)	(0.033)	(0.033)
Location (= large city)	-0.099***	-0.101***	0.021	0.024	-0.098***	-0.106***	0.022	0.031
	(0.032)	(0.032)	(0.023)	(0.023)	(0.032)	(0.032)	(0.023)	(0.023)
Households consumption share (log)	1.071***	1.064***	-0.731***	-0.724***	1.004***	0.796***	-0.227	0.001
	(0.149)	(0.149)	(0.116)	(0.117)	(0.225)	(0.246)	(0.170)	(0.184)
Government consumption share (log)	-0.495***	-0.465***	0.269**	0.238**	-0.474***	-0.693***	0.328***	0.567***
	(0.160)	(0.160)	(0.120)	(0.120)	(0.162)	(0.186)	(0.121)	(0.128)
Investment	0.010**	0.009*	-0.014***	-0.013***	0.008	0.006	-0.007*	-0.005
	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
Sales 3 years ago (log)	0.023***	0.023***	-0.003	-0.003	0.023***	0.023***	-0.003	-0.004
	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)
Trade openness (log)	-0.318	-0.273	0.132	0.084	-0.223	-0.089	0.053	-0.093
	(0.218)	(0.219)	(0.152)	(0.151)	(0.194)	(0.207)	(0.138)	(0.144)
GDP per capita growth (log)	-0.748***	-0.814***	0.389***	0.459***	-0.780***	-0.672***	0.351**	0.233
	(0.200)	(0.203)	(0.148)	(0.151)	(0.198)	(0.202)	(0.149)	(0.151)
GDP growth (log)	0.766***	0.830***	-0.395***	-0.463***	0.797***	0.691***	-0.358**	-0.243
	(0.198)	(0.201)	(0.146)	(0.149)	(0.196)	(0.200)	(0.147)	(0.149)
Rule of Law	-0.576***	-0.539***	0.053	0.014	-0.509***	-0.476***	0.071	0.034
	(0.187)	(0.188)	(0.143)	(0.145)	(0.160)	(0.161)	(0.124)	(0.125)
l.Electricity access per population*l.Undervaluation		-0.172**		0.183***				
		(0.080)		(0.064)				
l.Depreciation (log)					-0.027	1.965*	0.529***	-1.646**
					(0.185)	(1.029)	(0.143)	(0.820)
l.Electricity access per population*l.Depreciation						-0.583**		0.636***
						(0.289)		(0.228)
Observation	12454.000	12454.000	12452.000	12452.000	12454.000	12454.000	12452.000	12452.000
F-stats	122.420	116.068	57.057	55.232	122.466	115.457	57.579	55.218
R^2	0.285	0.286	0.222	0.223	0.285	0.286	0.223	0.224
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Chapter 4

Remittances and Industrialization

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Abstract

Sub-Saharan African firms face enormous obstacles to their development. The main constraints to business performance identified are poor access to finance and a weak domestic market. In this paper, we examine how international remittances affect firms' performance. Specifically, we investigate the role of remittances on capital accumulation, sales, and employment in 34,010 firms operating in 42 Sub-Saharan African countries between 2006 and 2020. Using a fixed-effect instrumental variable approach to control for the endogeneity of remittances, we find that international remittances positively affect the share of capital held by nationals in manufacturing firms. Moreover, international remittances positively affect sales in non-manufacturing firms, while a negative effect on the sales of manufacturing firms is observed. Regarding the effect of remittances on employment, we find a positive impact on both manufacturing and non-manufacturing firms. Heterogeneity tests suggest that the effect of remittances on firms' performance is larger in less financially developed and non-resource-rich countries. As for the negative impact of remittances on sales in manufacturing firms, the results show that it is entirely due to small firms. Finally, using remittances per capita instead of remittances relative to GDP, similar result are found.

4.1 Introduction

Firms' growth is a key driver of economic development.[1] Their expansion affects the standard of living by increasing supply, employment, wage and productivity. However, firms in developing countries face several constraints that prevent or slow their growth. The main obstacles reported by firms in these countries are poor access to finance, high tax rates, limited access to electricity, and competition from the informal sector[2] (Figure 4.1). For instance, in Sub-Saharan Africa (SSA), 21% of firms report that access to finance is the main barrier to their operations, compared to 14.36% of firms in developing countries as a whole and 12.55% in developing countries outside SSA (Figures 4.2 and 4.3).

At the same time, remittances from African migrants have continued to increase, making SSA the second-largest recipient of remittances relative to GDP, behind South Asia (Figure 4.4). From $20 billion in 2005, remittances to Africa more than doubled in 2019 to over $40 billion. (Figure 4.5). Figures 4.5 and 4.6 show that remittances to SSA have not only increased significantly in recent years but, more importantly, have surpassed the other two sources of external financing, namely foreign direct investment (FDI) and Official Development Assistance (ODA). Furthermore, it can be noted that, unlike FDI, for instance, remittance flows are much more stable. Given the magnitude of these amounts, the question arises as to whether remittances can help alleviate some of the constraints discussed above and promote enterprises development. Specifically, how do remittances affect capital accumulation, domestic supply through domestic demand and employment in SSA countries

There are four main channels through which remittances can affect firms performance. First, they can reduce the liquidity constraints of firms (investment effect) so the obstacles related to financing. Indeed, remittances can enable recipients and senders to invest in the home country by buying shares in existing firms (intensive margin) or creating new firms (extensive margin). Second, remittances

[1] The terms firms, enterprises and companies have the same sense in this paper, so they are used alternately.

[2] The competition from the informal sector comes in part from products' imports to meet domestic demand.

can affect firms activities through recipients' expenditures, therefore, domestic demand. As additional income, remittances can enable recipients to increase their demand and thus sales in local companies. The third channel, employment, directly results from the previous two. Indeed, the acquisition of capital in existing firms and the entry of new firms into the market could lead to investments in inputs such as labour, which could increase employment in firms. Similarly, the rise in local demand by the recipients would increase firms' supply and thus their demand for labour. Furthermore, remittances can also affect employment through the labour market participation of recipients (Acosta (2006), Amuedo-Dorantes & Pozo (2006) and Hanson (2005)). Finally, remittances can influence firms performance by sustaining recipients' consumption during recessions, thereby reducing volatility and macroeconomic risk.

This paper is close to the literature on remittances and entrepreneurship and remittances and expenditures. Studies on the effects of remittances on promoting enterprise development in migrants' countries of origin are scarce and mixed. While some papers have found a negative or no effect of remittances on entrepreneurship, others have found a positive impact. In the first set, Amuedo-Dorantes & Pozo (2006), in a study of the Dominican Republic, show that receiving remittances has a negative effect on the probability of owning a business. Similarly, Ang et al. (2009) find no significant impact of remittances on productive investment in the Philippines. Likewise, Vasco (2013) shows that neither migration nor remittances affect the probability of owning a business in rural Ecuador. Conversely, in the case of Mexico, Massey & Parrado (1998) found that remittances from the United States have a significant effect on firm investment. Lopez-Cordova et al. (2006) also found that remittances are an important source of capital for micro-enterprises. Similarly, Woodruff & Zenteno (2007) showed that Mexican small and medium-sized firms benefit financially from their connections to migrant networks in the United States. In the same way, Yang (2008) notes that a positive economic shock in the migrants' destination country leads to higher levels of entrepreneurial investment in origin households in the Philippines. Likewise, Vaaler (2011) finds that international remittances increase venture capital funds and business startups in migrants' home countries. More recently, Efobi et al. (2019) assessed the direct and indirect impact of remittances on industrialization using a panel of 49 African countries for the period 1980-2014. They find that remittances can stimulate industrialization through the financial development mechanism.

Regarding the spending effect of remittances, Adams Jr & Cuecuecha (2010*a*) show that remittances have a positive impact on marginal spending on food in Indonesia. Clément (2011) finds similar results in Tajikistan. Using a propensity score technique, he shows that international remittances positively affect household consumption. Likewise, Zhu et al. (2012) conclude that remittances are largely used for consumption purposes by Chinese rural households. Similar results were found by Cattaneo (2012) in Albania. In a similar vein, Zhu et al. (2014) study the impact of migrant remittances on consumption patterns in China. Using a large homogeneous sample of rural households surveyed in 2001 and 2004, they find that remittances are spent on non-housing consumption expenditures at the margin, virtually dollar for dollar. Thapa & Acharya (2017) use data from the 2010/2011 Nepal Living Standards Survey to study the effect of remittances on household spending patterns. Their results show that remittance recipient households tend to spend more on consumption. Abdih et al. (2012) also find that remittances positively affect consumption of imported and locally produced goods in the Middle East, North Africa, and Central Asia (MENA) countries. The elasticity of this impact ranges from 0.06 to 0.12. Farzanegan & Hassan (2020) pointed out that remittances have a boomerang effect on imports, increasing the competitive pressure on domestic firms and thus reducing their domestic sales. Finally, Glytsos (1993) and Steinmann (1991) found a positive effect of remittances on imports in four European countries. Specifically, between 1960 and 1981, remittances increased imports by 1% in Spain and Italy, by 4.9% in Greece, and by 6.2% in Portugal.

Our study differs from the existing literature in several ways and makes three clear contributions. First, to our knowledge, this paper is the first to analyze the effect of remittances on enterprise development in SSA. Secondly, unlike the existing literature on household or macroeconomic data, we focus on firm-level data. The advantage of this approach is that it allows us to directly examine the effect of remittances on several firm outcomes (capital accumulation, sales, employment, etc.). Third, we analyze the impact of remittances on both manufacturing and non-manufacturing sectors. This approach will allow policymakers to clearly understand the impact of remittances on firm activities across sectors and thereby better target economic policies.

Using the fixed effects instrumental variables approach and a large sample of survey data on firms in 42 Sub-Saharan African countries between 2006 and 2020, we examine how international remittances contribute to firms' capital accumulation, sales, and job creation. The results first show that international remittances increase capital acquisition by nationals in manufacturing firms but not in non-manufacturing firms. Second, we find that international remittances negatively affect sales in manufacturing firms and positively impact non-manufacturing firms' sales. Finally, we observe a positive effect of remittances on employment in both manufacturing and non-manufacturing firms.

The remainder of the paper is structured as follows: Section 4.2 outlines the theoretical framework underpinning the relationship between remittances and firm development. The data used and the identification strategy are described in Sections 4.3 and 4.4, respectively. Section 4.5 presents the main results. In Section 4.6, we perform some heterogeneity tests. Section 4.7 presents some robustness checks, and Section 4.8 concludes.

4.2 Theoretical framework: remittances and firm performance

There are four main transmission channels through which remittances affect firms performance namely investment effect, spending effect, employment effect and volatility-reducing effect.

4.2.1 Investment effect of remittances

In countries like SSA, where access to credit is limited, remittances as an additional resource can help overcome some of the liquidity constraints (Mora & Taylor (2006), Kifle (2007), Yang (2008), Adams Jr & Cuecuecha (2010*b*)) and thus facilitate investment (Woodruff & Zenteno (2007)). Therefore, remittances can affect capital accumulation in firms through both the intensive and the extensive margin. From the intensive side, remittances can be used to acquire shares in existing firms, thereby increasing the share of firms owned by nationals. From the extensive perspective, remittances can help finance new enterprises, which will increase the number of companies and thus domestic production.

Furthermore, remittances can positively impact investment through access to loans. The idea is that remittances can alleviate the collateral constraints faced by borrowers. Some papers have empirically demonstrated the complementarity between remittances and loan. For instance, Ratha et al. (2007) show that remittances indirectly contribute to a recipient household's ability to engage in business activities by facilitating access to loans for micro or small enterprises. Richter (2008), also finds that the amount of remittances received at the household level positively affects the demand for credit. Similarly, Aggarwal et al. (2011) provide evidence of a positive and significant effect of remittances on loans using data from 109 developing countries over 1975-2007. Mbaye (2021) leads to similar findings in rural areas of Senegal.

4.2.2 Spending effect of remittances

Numerous articles have shown that remittances are primarily used to meet the current consumption needs of recipients (Adams Jr & Cuecuecha (2010*a*), Clément (2011), Zhu et al. (2012), Cattaneo (2012), Zhu et al. (2014),Thapa & Acharya (2017)). As such, remittances can affect business activities through sales. In particular, if recipients prefer local products, remittances will increase the demand for goods produced by local firms. Thus, one can expect an increase in the production and sales of these firms. However, if, on the contrary, remittance recipients prefer imported products, either because they are of better quality or because they are cheaper, there will be competitive pressure on local firms, which will negatively affect their sales (Farzanegan & Hassan (2020), Glytsos (1993), Steinmann (1991)). In addition, when remittances received increase significantly, the marginal propensity to consume could decrease in favour of the marginal propensity to invest, which could also negatively affect firms' sales.

4.2.3 Employment effect of remittances

The effect of remittances on employment depends on the two previous effects, namely the investment effect and the expenditure effect (Shapiro & Mandelman (2016), Woodruff & Zenteno (2007), Zachariah & Rajan (2007), Chami et al. (2005)). First, acquiring capital in existing firms expands their ability to invest in inputs, including labour. Therefore, this intensive margin could contribute to an increase in the demand for labour by firms. Similarly, the entry of new firms into the market is likely to be accompanied by investments in inputs such as labour and capital, which could also be a source of labour demand. Second, as mentioned above, if remittances are used to purchase local goods, there should be an expansion of business activity through increased sales, ultimately leading to increased labour demand. However, if remittances are spent on foreign goods, the opposite effect will occur. Finally, remittances may also positively affect employment because of their impact on human capital investment.

4.2.4 Volatility-reducing effect of remittances

Besides the direct effects described above, remittances can affect firm performance by reducing volatility. Indeed, a vast literature has shown that remittances are counter-cyclical for economic activity in the migrants' home country (De et al. (2019), Mondal & Khanam (2018), Jidoud (2015), Combes & Ebeke (2011), Craigwell et al. (2010), Chami et al. (2009)). They tend to increase during recessions or economic downturns to allow recipients to maintain their consumption. In addition, Mohapatra & Ratha (2011) show that when households face high volatility and income shocks, remittances can also help smooth income and make households more attractive as borrowers. Therefore, by reducing volatility and macroeconomic risk, remittances could positively influence the investment decision.

4.3 Variables and data description

This paper combines firm-level data with country-level macroeconomic data. The firm-level data come from the World Bank Enterprise Surveys (WBES) and cover the period 2006-2020. The WBES is a nationally representative enterprise survey that provides a wide range of information on firms' characteristics, performance, and constraints in developing countries. The final database contains 34,645 enterprises in 42 countries, and about 90% of countries have at least two survey waves. Macroeconomic data are from the World Bank's World Development Indicators. Subsection 4.3.1 describes the main variables, while subsection 4.3.2 presents some descriptive statistics.

4.3.1 Variables description

Firms' variables

To assess the effect of international remittances on firm performance, we use the following three dependent variables :

- **Capital share owned by nationals** : This variable is the first dependent variable. It represents the percentage of the firm's capital held by domestic economic agents in the surveyed country. Since our objective is to examine whether remittances affect the performance of firms in recipient countries, the best way to do this is to assess whether recipients invest in firms. From this perspective, domestic economic agents' share of the firm is a good indicator of productive capital accumulation.

- **Firm's sales**: The second dependent variable is the firm's total annual sales. This variable is initially recorded in the country's local currency. However, we convert it to constant 2015 dollars and deflate it for inflation using the GDP deflator to facilitate cross-country comparisons. This variable allows us to understand whether remittances contribute to the growth of local businesses through the demand for local products.

- **Firms' employment**: The final dependent variable is the number of permanent full-time employees. These are all paid employees, hired for one or more fiscal years, guaranteed re-employment, and work up to 8 hours or more per day. The use of employment growth to measure increased business activity is not new. Several papers have previously used this variable as an indicator of firm performance (Coad (2010), Anyadike-Danes et al. (2009)).

The following variables are used as controls to account for some heterogeneity across firms :

- **Female ownership** : This variable provides information on the majority shareholder's gender, and it takes the value 1 if it is a woman and 0 otherwise. We control for this variable because the literature has shown that the probability of receiving remittances is higher for women in Sub-Saharan Africa (Plaza et al. (2011)).

- **Transport obstacle** : Since the poor quality of infrastructure service is a barrier to entrepreneurship and business output, we control transportation infrastructure quality. This variable is obtained by asking the manager to what extent the poor quality of the infrastructure service is an obstacle to the business. It includes the following modalities : (1) No obstacle, (2) Minor obstacle, (3) Moderate obstacle, (4) Major obstacle, and (5) Very severe obstacle. But in this study, we consider only the major and severe barrier dimensions. Thus, the quality of transportation infrastructure service is measured by a dummy variable that takes 1 if the barrier degree is major or very severe and 0 otherwise.

- **Location** : We also add firm location as a control variable to account for the agglomeration effect. Indeed, we can expect that remittances will not impact firms' activities in large cities as in small towns. The variable location is equal to 1 if the firm is located in a large city and 0 otherwise.

- **Size** : The variable size refers to the firm's size. We distinguish three categories of companies: small firms (less than 20 employees), medium firms (between 20 and 99 employees), and large firms (more than 100 employees). Controlling for this variable allows us to consider the effect of firm size.

Macroeconomics Variables

- **Remittances from migrants to SSA countries** : This variable is the explanatory variable of interest. It includes personal transfers (current cash or in-kind transfers) and worker compensation (wages of seasonal and other short-term SSA workers employed abroad). In the regressions, we use remittances to GDP in the baseline models and remittances per capita as robustness tests.

- **Trade** : The trade openness indicator represents the sum of exports and imports of goods and services as a percentage of GDP. This variable is included as a control because trade openness provides foreign sales opportunities for local firms on the one hand and imposes competitive pressure on them through imported products on the other.

- **Unemployment rate** : This variable is used as an independent variable because a high unemployment rate may, on the one hand, encourage individuals to turn to entrepreneurship and, on the other hand, reduce the cost of labor and thus the costs to firms. In addition, high unemployment can lead to a decline in people's income, which reduces their ability to invest.

- **Time required to start a business** : Time required to start a business is the number of calendar days needed to complete the procedures to legally operate a business. This variable aims to capture the cost of starting a business. For example, cumbersome procedures can encourage corruption and undermine entrepreneurship.

- **Real exchange rate** : The real exchange rate is the price level of output-based real gross domestic product per capita (CGDPo) at current purchasing power parity (PPP) rates defined relative to the US in 2017. An increase in the exchange rate reflects the depreciation of the local currency. This variable allows us to control for the effect of Dutch disease in remittances.

- **Domestic credit to private** : It refers to the financial institutions' financial resources provided to the private sector as a percentage of the deposit. These credits include loans, purchases of non-equity securities, trade credits and other accounts receivable, which give rise to a demand for repayment. We welcome this variable as an explanatory variable because it measures the ease of access to credit, impacting our dependent variables.

- **Political stability index** : This variable measures people's perception of political instability and violence. It ranges from -2.5 to 2.5. A score of -2.5 indicates a high level of political instability, while a score of 2.5 indicates a high level of political stability. The addition of this variable among the control variables allows us to consider the quality of the countries' institutions.

- **Control corruption index** : Among the obstacles to entrepreneurship identified in the countries of sub-Saharan Africa, corruption occupies a crucial place. For this reason, we control the level of corruption in the country. The variable used as a corruption index is the percentage of companies identifying corruption as a major constraint.

- **Electricity service quality** : As the quality of transportation infrastructure, power quality can be a critical factor in investing in a business. The quality of electricity access is measured in this paper by the average number of power outages a firm experiences in a typical month in the country.

- **GDP per capita**: is the total gross value added by all resident producers of the country plus taxes on products and less subsidies not included in the value of products relative to the total population. This variable reflects both the size of the economy and the level of national wealth. A higher GDP per capita means a substantial national market to satisfy and resources to invest in entrepreneurship.

- **Domestic investment** : Gross fixed capital formation (GFCF) includes land improvements (fences, ditches, drains, etc.), purchases of plant, machinery, and equipment, and the construction of roads, railroads, and other facilities, including schools, offices, hospitals, private residential housing, and commercial and industrial buildings. We control for this variable because one firm's investment in input is an opportunity for another firm's sales of final goods. Thus, an increase in GFCF can boost demand for local products and create a dynamic for entrepreneurship.

- **Remittances prices**: is the amount one must pay to send $200, as a percentage of the amount sent. It comes from the Remittance Prices Worldwide database. We use this variable as an instrument for international remittances.

- **Foreign-born employment rates interacted with emigration rates in OECD countries** : This variable serves as a second instrument. It is obtained by interacting two variables : (1) The foreign-born employment rate in OECD countries and (2) the emigration rate from each country to OECD countries. They are collected from the OECD database (DIOC).

4.3.2 Data description

As mentioned earlier, this paper combines firm-level and macroeconomic data. Table 4.1 shows that about 90% of countries have at least two waves of the enterprise survey. This table also shows the year of the survey, the total number of firms surveyed, and the manufacturing and non-manufacturing firms surveyed in each wave by country. Overall, the number of firms surveyed per wave is higher in Kenya, Nigeria, and South Africa than in other Sub-Saharan African countries.

In Table 4.2, we present the number of firms and each industry's share by sector. We can see that non-manufacturing and manufacturing firms represent 55%

and 45% of the overall sample, respectively. Wholesale and retail trade (72,61%), hotels and restaurants (12.10%), and construction (6,66%) represent the largest share of industries in the non-manufacturing sector. In the manufacturing sector, the over-represented industries are food (26.39%), clothing (13.33%), and furniture manufacturing (11.50%).

Table 4.3 presents the summary statistics of the main variables used in our study. First, we find that, on average, the share of capital held by nationals, which is the first dependent variable, is 81.84%. This rate stands at 83% in the manufacturing sector and 81% in the non-manufacturing sector. On average, the surveyed firms employ 55 permanent full-time employees. Manufacturing firms (71) have more employees on average than non-manufacturing firms (42). In terms of sales, the annual amounts reported by manufacturing firms are on average higher than those of non-manufacturing firms. Concerning the remittance variables, the amount of remittances received represents on average 3.13 percent of total GDP. The annual per capita amount received is $ 43.

4.4 Empirical specification

To estimate the effect of international remittances on business activities, the basic econometric model is :

$$Y_{f,i,c,t} = \alpha + \beta R_{c,t-1} + \gamma X_{c,t-1} + \delta F_{f,i,c,t} + \Psi_i + \Theta_c + \Phi_t + \epsilon_{f,i,c,t} \tag{4.1}$$

Where $Y_{f,i,c,t}$ is one of our three measures of business activity *(Share of the firm owned by nationals, firm sales, and firm employment)* in firm f, industry i, country c at time t. $R_{c,t-1}$ is our variable of interest. It represents the international remittances (expressed as percentage of GDP) received by country c at time t-1. We use lagged remittances because the effect of remittances on business activities may not be instantaneous. One can imagine, for example, that people who receive remittances will first try to satisfy their daily consumption needs. Only later, when they have saved enough, can they invest in business activities. Therefore, remittances received in year t do not necessarily affect the capital held by nationals in the same year. $X_{c,t-1}$ is a vector of country-level control variables that can affect our dependent variables, while F_{fict} represents a vector of firm-level control variables. To deal with the likely endogeneity of these control variables, especially because of possible reverse causality, we consider the lags of these variables. Ψ_i, Θ_c and Φ_t are industry, country and year fixed effects, respectively. ϵ_{ict} is an idiosyncratic error term.

Although adding industry, country, and year fixed effects and using lagged remittances allows us to control for time-invariant heterogeneity and reverse causality, there may still be an unobserved, time-varying omitted variable that affects remittances and business activities. To overcome the remaining endogeneity issue, we use the instrumental variables approach. Specifically, we use the following two instruments : (1) remittance prices and (2) foreign-born employment rates in OECD countries interacted with the emigrant rate from country c in OECD countries.

Regarding the first instrument, we use, more specifically, the average cost of sending $ 200 to country i. The idea behind this choice is that transaction costs, in particular transfer prices, can be a major obstacle to sending money. If it is more expensive to remit to country i, the volume of remittances sent by migrants to that country may decrease. Therefore, a negative relationship between the average cost of remittances and the amount of remittances received is expected. Many articles have already highlighted the role of remittance prices on the volume of remittances. For instance, Freund & Spatafora (2008) find that remittances depend negatively on transfer costs and exchange rates restrictions. Gibson et al. (2019) also show that remittances have negative cost elasticity.

Our second instrument is the foreign-born employment rate in OECD countries interacted with the emigration rate of country c in OECD countries. The use of migrants' economic conditions in destination countries as an instrument for sending remittances is not new (Acosta et al. (2008), Amuedo-Dorantes & Pozo (2011)). The rationale behind this instrument is that if foreign-born employment rates increase in destination countries, migrants' incomes may increase, which means they will have more money to send home. Therefore, one would expect a positive relationship between foreign-born employment rates in destination countries and remittances received in migrants' countries of origin. However, to allow the effect of foreign-born employment rate in OECD countries on remittances to vary across countries, We weight the foreign-born employment rate in OECD countries by the emigration rate from each country c to OECD countries. We focus on migrants' economic conditions in OECD countries, as they are the main remittance-sending countries to Sub-Saharan Africa (Ratha et al. (2020)).

Figure 4.7 shows the relationship between remittances received relative to GDP and the cost of sending $200 to a specific country and the relationship between the weighted foreign-born employment rate in OECD countries and remittances to GDP received. As expected, we can observe in Figure 4.7 that the amount of remittances received is lower when the cost of sending remittances is higher (left graph). In contrast, there is a positive relationship between remittances and the weighted foreign-born employment rate in OECD countries (right chart).

Our claim is that, conditional on the set of control variables included in our specification, the unobserved components of the dependent variables are uncorrelated with these two instruments. Based on the above, we use an instrumental variable fixed effects (IVFE) approach where, first, we estimate the amount of international remittances received in t-1 as follows:

$$R_{ct-1} = \alpha + \beta Z_{ct-1} + \gamma X_{t-1} + \delta F_{f,i,c,t} + \Psi_i + \Theta_c + \Phi_t + \nu_{ct} \tag{4.2}$$

Where R_{ct-1} is the suspected endogenous variable at time t-1 (Amount of international remittances to GDP). Z_{ct-1} is a vector of the instrumental variables described above at time t-1.

The second-stage equation estimating the effect of international remittances on business activities can be estimated as follows:

$$Y_{f,i,c,t} = \alpha + \beta \widehat{R}_{c,t-1} + \gamma X_{c,t-1} + \delta F_{f,i,c,t} + \Psi_i + \Theta_c + \Phi_t + \epsilon_{f,i,c,t} \tag{4.3}$$

Where $\widehat{R}_{c,t-1}$ is the fitted values of R_{ct-1} from the first stage. Y_{ict}, X_{ct-1}, F_{fict}, Ψ_i, Θ_c and Φ_t are the same variables described in equation 4.2. Our coefficient of interest is β.

4.5 Results

In this section, we present the main results of our analysis, starting with the effect of remittances on investment, followed by that on firm sales, and finally, the impact of remittances on employment.

4.5.1 Effect of remittances on capital owned by nationals

The first way to study the productive use of remittances in SSA is to analyze their effect on the participation of nationals in the capital of firms. The point is that if remittances are used for investment purposes, we could observe a positive impact of remittances on the share of firms owned by nationals. The results of this analysis using ordinary least squares (OLS) and the fixed effect model are presented in Table 4.4. In the first three columns, where we report the results of the OLS model, we find a positive effect of remittances on the share held by nationals. Specifically, on average, a 1 percentage point increase in remittances to GDP leads to a rise in capital held by nationals of about 0.556 percentage points in the total sample (column 1). This positive effect is observed in both the manufacturing (+0.680) and non-manufacturing (+0.538) sectors. Results including year, country and industry fixed effects are shown in columns 4, 5 and 6. Overall, we find that remittances positively affect the share held by nationals only in the manufacturing sector with this model.

However, neither model adequately deals with the endogeneity of remittances raised earlier. We use a fixed-effects instrumental variable approach (IVFE) to address this issue. The first and second stages results are presented in Tables 4.5 and 4.6. As expected, Table 4.5 shows that the instruments used well predict international transfers. Indeed, the weighted foreign-born employment rate in the OECD is positively and significantly associated with remittances received in SSA countries, while the cost of remittances affects negatively international remittances. We can also note at the bottom of Table 4.6 that the instruments used are relevant. They pass both weak identification and under-identification tests. Indeed, the Kleibergen-Paap Wald F rk statistic for weak identification is well above the critical values of Stock-Yogo. Moreover, the p-value associated with the Kleibergen-Paap LM rk statistic is below 5% which allows to reject the null hypothesis of no correlation between the instruments and the endogenous variable.

The second stage estimation results are presented in Table 4.6. The first three columns give the results for the entire sample. The following three columns show the manufacturing sector results, and the last three columns report the results of the non-manufacturing sector. First, we find that international remittances have a positive and statistically significant effect on the share of capital held by nationals in the overall sample. More precisely, a 1 percentage point increase in remittances relative to GDP tends to increase the percentage of capital held by citizens by 1.10 percentage points (column 1). We then gradually introduce GDP per capita and domestic investment, as these variables are transmission channels for remittances. The objective is to test the robustness of the effect to the inclusion of these variables. Columns 2 and 3 show that controlling GDP per capita and domestic investment only slightly reduces the effect size.

As for the sectors in which people invest, the results show that remittances have a positive and statistically significant impact in the manufacturing sector only. In the full model (column 6), the effect of remittances on the share held by nationals in this sector is about 1.40 percentage points.

4.5.2 Effect of remittances on firm sales

Since a significant portion of remittances is used for consumption purposes (Adams Jr & Cuecuecha (2010*b*), Clément (2011), Zhu et al. (2012), Thapa & Acharya (2017)), we examine how remittances affect business sales in SSA in this subsection.

Table 4.7 displays the results using OLS and the fixed effect model. Both models show a negative effect of remittances to GDP on firm sales. However, the results change when we correct for the endogeneity of remittances, as shown in Table 4.8. Contrary to the previous results, we find a positive effect of remittances on firm sales. In particular, a 1 percentage point increase in remittances to GDP leads to a

0.08% increase in firm sales in the full model (column 3). Looking at the effect by sector, we find that remittances increase sales for non-manufacturing firms, while an adverse effect is observed for manufacturing firms. Note that a 1 percentage point increase in remittances to GDP raises sales of non-manufacturing firms by 0.125% and reduces those of manufacturing firms by 0.129%.

These results are not surprising for at least two reasons. First, a large empirical literature has shown that remittances in developing countries are spent more on health, housing, food and services (Thapa & Acharya (2017), Mohanty et al. (2014), Zhu et al. (2012), Clément (2011), Adams Jr & Cuecuecha (2010*b*), Yang (2008), Kifle (2007), Mora & Taylor (2006), Lucas (2005)). The fact that most of these goods are provided by the non-manufacturing sector could explain the positive effect observed in this sector. Second, the increase in the income of remittance recipients could lead them to prefer foreign products to domestic ones, either because imported products are of better quality or because they are cheaper. This preference for foreign manufactured goods could reduce the domestic manufacturing firms' sales on the one hand and increase the sales of non-manufacturing importing firms, such as wholesale and retail trade, on the other (Farzanegan & Hassan (2020), Glytsos (1993), Steinmann (1991)). This substitution effect is particularly plausible in the case of SSA countries, given their low level of industrial development.

4.5.3 Effect of remittances on employment

In this subsection, we examine whether international remittances affect business employment. We focus on the permanent full-time employment, which are more stable and decent jobs.

Table 4.9 reports the results using the OLS and fixed-effects models. The OLS results show a positive effect of remittances on employment regardless of the sector of activity (columns 1-3). However, in the fixed-effect models, a positive and significant impact is found only on employment in non-manufacturing firms. The results using the IVFE approach are presented in Table 4.10. First, we find a positive and statistically significant effect of remittances on the number of permanent full-time employees. For instance, in the full model, a 1 percent point increase in remittances to GDP results in a 0.05% increase in the number of permanent full-time employees. Second, when we examine the effect by sector, we find that the positive effect remains regardless of the sector considered. But the magnitude of the effect is much more prominent in the non-manufacturing sector. Indeed, an increase in remittances to GDP of one percentage point leads to an increase in employment in the non-manufacturing sector of 0.08%, compared to 0.04% in the manufacturing sector.

There are two points to note about these results. First, despite the negative effect of remittances on manufacturing sales observed in the previous subsection, we find a positive impact on manufacturing employment. This could be due to the investment effect of remittances in the manufacturing sector observed in subsection 4.5.1. Indeed, the purchase of shares in existing firms, for example, could increase their capital and boost their ability to invest in inputs such as labour. Similarly, the entry of new firms into the market may be accompanied by new investments in labour and capital. Second, for the non-manufacturing sector, it appears that the positive effect of remittances on employment is entirely due to the spending effect of remittances. In general, non-manufacturing firms tend to be more labour-intensive than manufacturing firms. They involve a significant degree of customization or interaction with customers, so their operations depend highly on employees. In this context, an increase in remittance driven demand will push these companies to expand their offerings by hiring more staff to meet these new needs.

4.6 Heterogeneity tests

In this section, we perform several heterogeneity tests. Note that in this section, we focus mainly on the results using the instrumental variables approach.

4.6.1 Does the effect of remittances depend on the level of financial development of countries?

This part examines whether the effect of remittances on capital accumulation depends on the country's financial development. Indeed, since remittances alleviate liquidity constraints, one would expect the impact of remittances on firm ownership to be greater in countries with low financial development.

To perform this heterogeneity test, we consider the share of domestic credit to the private sector relative to GDP as an indicator of financial development. We first exclude the top 25% of financially developed countries. Table 4.11 summarizes the results of this first analysis. As previously, we find a positive and statistically significant effect of remittances on capital held by nationals in the manufacturing sector. However, when we compare the impact size, the effect is larger (1.891) than what we found with the entire sample (1.414) in Table 4.6.

Second, we alternately exclude the 25% least financially developed countries. The idea is that if the effect of remittances is larger in the less financially developed countries, we might have a smaller or no effect when we exclude these countries. The results reported in Table 4.12 confirm what we found earlier. The effect of remittances on the share held by nationals is smaller and statistically insignificant. Taken together, these results reveal that remittances are mainly used for investment purposes in countries with low levels of financial development.

4.6.2 Exclusion of major remittance-receiving countries

The second test of heterogeneity that we perform concerns the level of dependence of countries on remittances. According to the "Samaritan's dilemma," people who are highly dependent on remittances may substitute entrepreneurship and labour force participation for leisure. Thus, countries that rely heavily on remittances may have low levels of entrepreneurship.

We test this possibility by excluding the major remittance-receiving countries. We consider countries for which remittances represent at least 10% of GDP as the main beneficiaries. The rationale is that if there is a "Samaritan's dilemma", the effect of remittances on firm performance would be higher without countries that are highly dependent on remittances.

Table 4.13 displays the results of this heterogeneity test. Overall, we find similar results to the full sample. For instance, the effect of remittances on GDP on the share held by nationals is 1.396 when we exclude versus 1.402 in the whole model (Table 4.6). As for the effect of remittances on the sales of non-manufacturing firms, the coefficient obtained is 0.098 in the sample excluding top receivers versus 0.125 in the entire sample (Table 4.8). All of these findings reject the "Samaritan's dilemma" risk.

4.6.3 Exclusion of resources-dependent countries

According to the Dutch disease phenomenon, in resource-rich countries, resources such as labour and financial flows shift from other sectors to the natural resource sector. This subsection examines whether this is also true for migrant remittances. To do so, we exclude resource-rich countries from the sample and compare the effect of remittances with that found when we include them. Resource-rich countries are countries where rents represent more than 10% of GDP. If the Dutch disease phenomenon also holds for remittances, the effect of remittances on firm performance should be larger when these countries are excluded from the sample.

As expected, Table 4.14 shows that excluding resource-rich countries increases the size of the investment effect of remittances in the manufacturing sector relative to the overall sample. Specifically, an increase of 1 percentage point in remittances relative to GDP leads to an increase of 2.913 percentage points in the capital held by nationals (column 2). In comparison, the increase in shares held by nationals induced by remittances is 1.402 percentage points for the entire sample. The impact of remittances on manufacturing employment rises from 0.04% in the full model to 0.10% in non-resource-rich countries (column 8). For manufacturing sales, the effect of remittances becomes positive when resource-rich countries are excluded, whereas it was negative in the entire sample. Precisely, a 1 percentage point increase in remittances to GDP increases manufacturing sales by 0.256% (column 5) without resource-rich countries. In contrast, remittances reduce sales of manufactures by 0.129% in the whole model. Moreover, the effect of remittances on non-manufacturing sales (0.752%) is higher in this specification than in the baseline model (0.125%).

4.6.4 Effect of remittances according to firm size

Finally, we investigate how the effect of remittances on the different outcomes varies according to firm size. We distinguish three categories of firms based on their size: (1) small firms (less than 20 employees), (2) medium firms (between 20 and 99 employees), and (3) large firms (over 100 employees). We report the results of this analysis in the Table 4.15. Panels A, B, and C show the effect of remittances on the share of domestically owned firms, sales, and employment, respectively.

In panel A, we first find that remittances positively affect the share of capital held by nationals in all small firms (column 1). However, this effect is no longer significant when examining each sector (columns 2 and 3). In columns 4-6, where the impact of remittances on ownership in medium-sized firms is reported, we note a positive effect only in the manufacturing sector. The last three columns in Panel A suggest that remittances do not positively impact the share of capital held by nationals in large firms.

Regarding the effect of remittances on sales by firm size, Panel B highlights two key findings. First, we find that small firms drive the negative effect of remittances on manufacturing firm sales observed above (column 2). This result confirms the hypothesis that when remittances increase, recipients prefer higher quality imported goods to locally produced goods. In general, small manufacturing firms tend to have more constraints to improve the quality of their products, so they are the most affected by this preference for imported goods. Second, we find that remittances positively affect the sales of medium and large non-manufacturing firms.

Finally, the employment results presented in Panel C indicate a positive and statistically significant effect of remittances on employment in small and medium-sized non-manufacturing firms. We also find that remittances positively affect employment in medium-sized manufacturing firms.

4.7 Robustness checks

This section tests the robustness of the results to the choice of the variable of interest. Specifically, we use per capita remittances to measure transfers instead of remittances relative to GDP.

Table 4.16 presents the results of the effect of remittances per capita on the share of firms owned by nationals. In the last three columns, where results using the instrumental variable fixed effects approach are reported, we find that remittances per capita positively affect domestic ownership in manufacturing firms. Specifically, we observe that a 1% increase in remittances per capita increases the share of manufacturing firms owned by nationals by 0.145 percentage points. Estimates of the effect of per capita remittances on business sales are shown in Table 4.17. As with remittances to GDP, we find that remittances per capita negatively affect the sales of manufacturing firms. However, the impact of remittances per capita on the sales of non-manufacturing firms is not statistically significant. Finally, Table 4.18 shows a positive and statistically significant effect of remittances per capita on full-time employees, regardless of sector.

Overall, the results for remittances per capita are consistent with those for remittances to GDP, confirming the robustness of the results to the choice of the variable of interest.

4.8 Concluding remarks

This paper explores the effect of Sub-Saharan Africa's new main source of external finance, remittances, on firm performance. Specifically, we use a fixed-effect instrumental variable approach and a large sample of firms in 42 Sub-Saharan African countries between 2006 and 2020 to examine how remittances contribute to capital accumulation, firm sales, and job creation in this region. The results highlight three key findings.

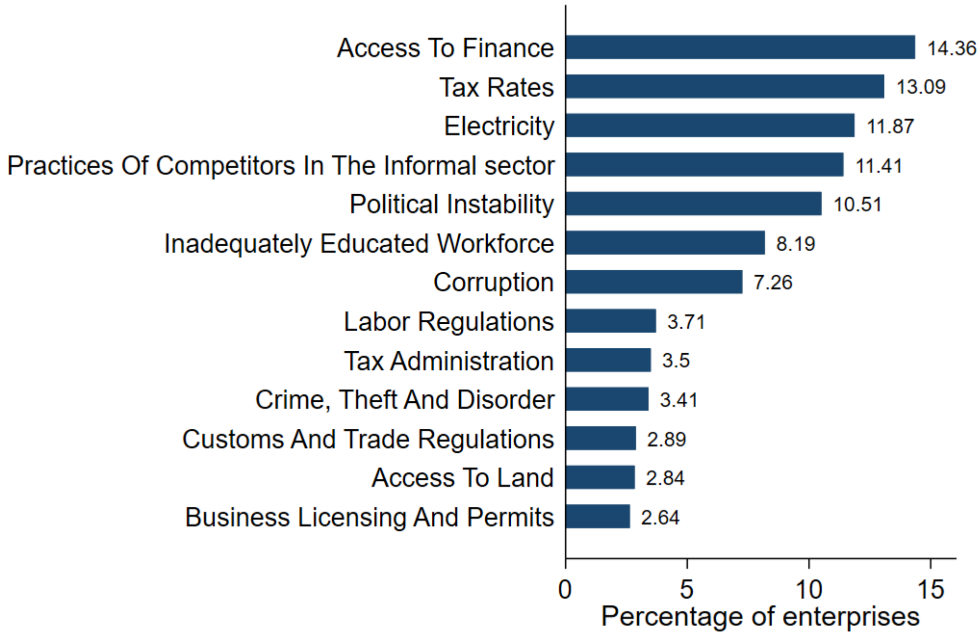
First, the results show that international remittances increase the acquisition of capital by nationals in manufacturing firms. Specifically, we find that international remittances to GDP increase the share of firms owned by nationals in this sector by 1.40 percentage points. Second, analysis of the effect of international remittances on firm sales reveals a negative impact of remittances to GDP on the sales of manufacturing firms and a positive effect on non-manufacturing firms. A 1 percentage point increase in remittances to GDP increases sales of non-manufacturing firms by 0.125% and reduces sales of manufacturing firms by 0.129%. Finally, we observe a positive effect of remittances on job creation in manufacturing and non-manufacturing firms. Especially, a 1 percentage point increase in the share of remittances in GDP leads to a rise in employment of 0.08% in the non-manufacturing sector and 0.04% in the manufacturing sector.

We also conducted several heterogeneity tests that yielded interesting results. The first heterogeneity test shows that the impact of remittances on capital accumulation is higher in the less financially developed countries. Indeed, we find an increased effect of remittances on the share of firms owned by nationals when we exclude the most financially developed countries compared to the baseline model. Second, our results do not seem to be influenced by the main recipient countries of remittances since the results remain unchanged when we exclude these countries. Third, the results show that the effect size is very large in non-resource rich countries. Finally, we find that remittances mainly improve the performance of medium-sized firms.

The last section shows the robustness of the results to the choice of the variable of interest. Similar results are found when per capita remittances are used as an indicator instead of remittances relative to GDP.

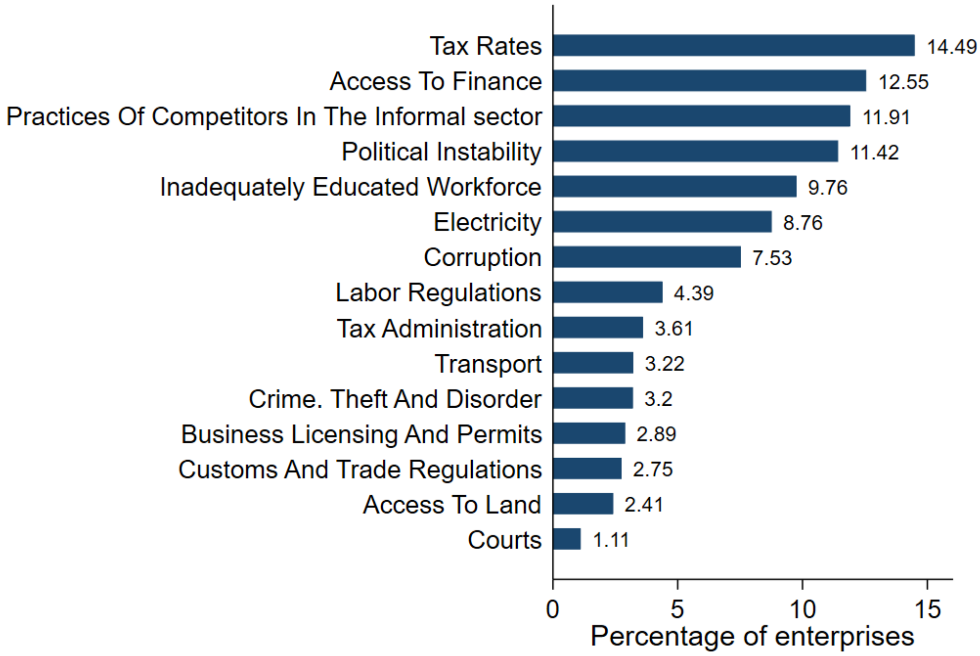
These results have several policy implications. First, the positive effect of remittances on investment suggests a productive use of remittances. This demonstrates that remittances can be a source of finance for the manufacturing sector, which faces enormous difficulties in accessing finance. However, the lack of impact in the non-manufacturing sector suggests the persistence of other challenges to entrepreneurship, such as business profitability, poor infrastructure (roads, electricity, etc.), bureaucracy and corruption. If these barriers are removed, the investment effect of remittances in this region can be substantial. Second, the negative effect of remittances on manufacturing sales indicates a substitution of foreign industrial products for domestic manufactured goods. This phenomenon mainly affects small manufacturing firms. Therefore, to improve their sales and benefit from the spending effect of remittances, African manufacturing firms need to enhance the competitiveness of their products. Policymakers can also play a key role in improving the quality of local products by ensuring adequate transport and energy infrastructure. Policymakers can also help promote local products, especially those produced by small firms, by subsidizing them.

Figure 4.1: Biggest obstacles affecting the operations of firms in all developing countries



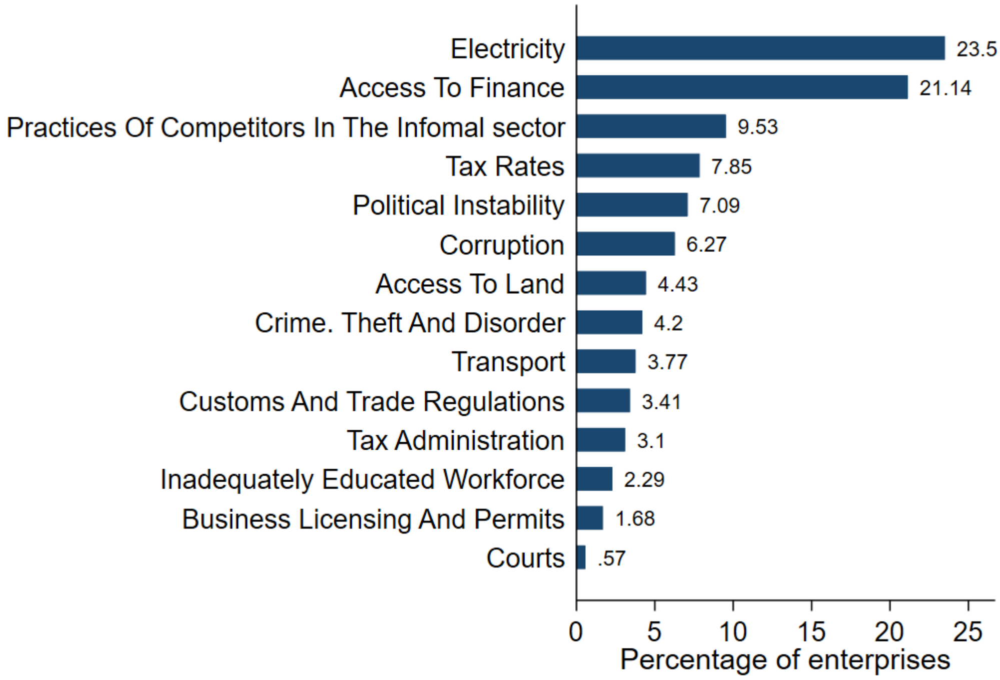
Source: Authors using WBES data

Figure 4.2: Biggest obstacles affecting the operations of firms in other developing countries



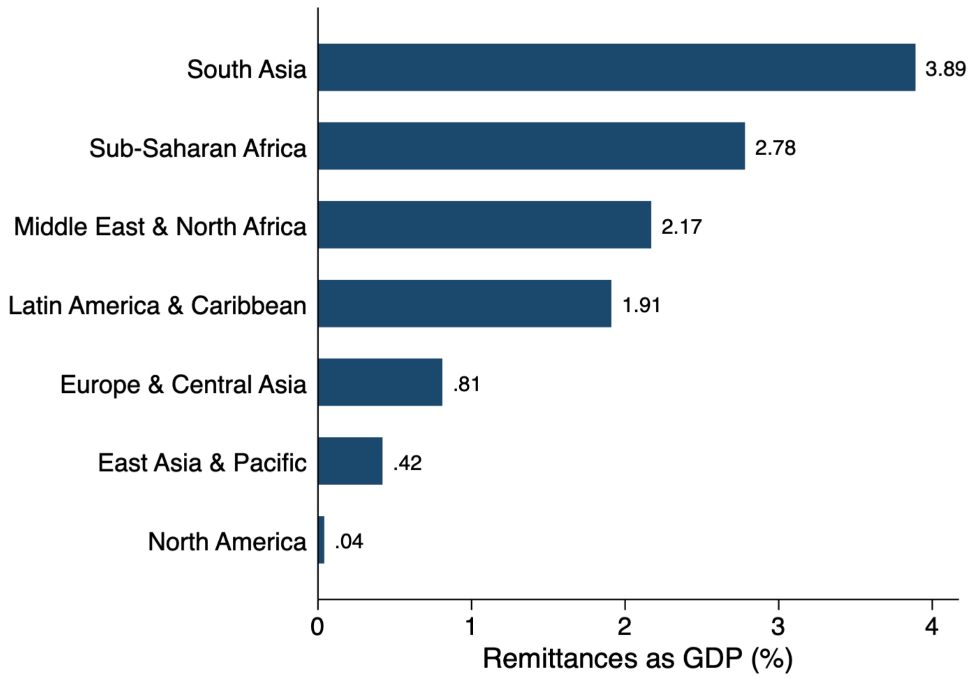
Source: Authors using WBES data

Figure 4.3: Biggest obstacles affecting the operations of firms in Sub-Saharan African countries



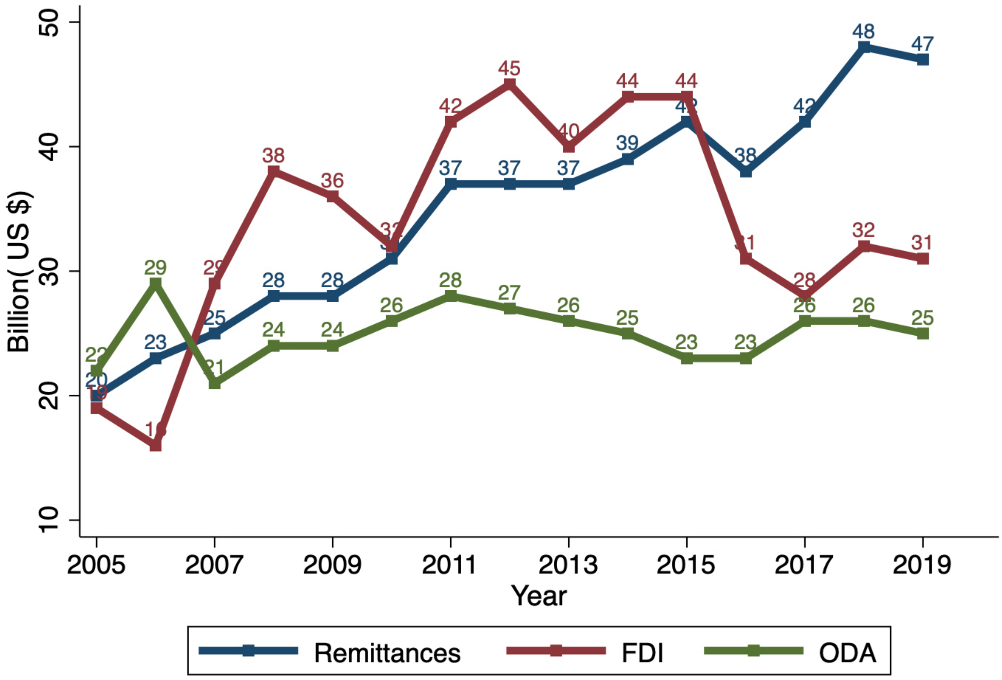
Source: Authors using WBES data

Figure 4.4: Remittances per GDP by world bank regions classification



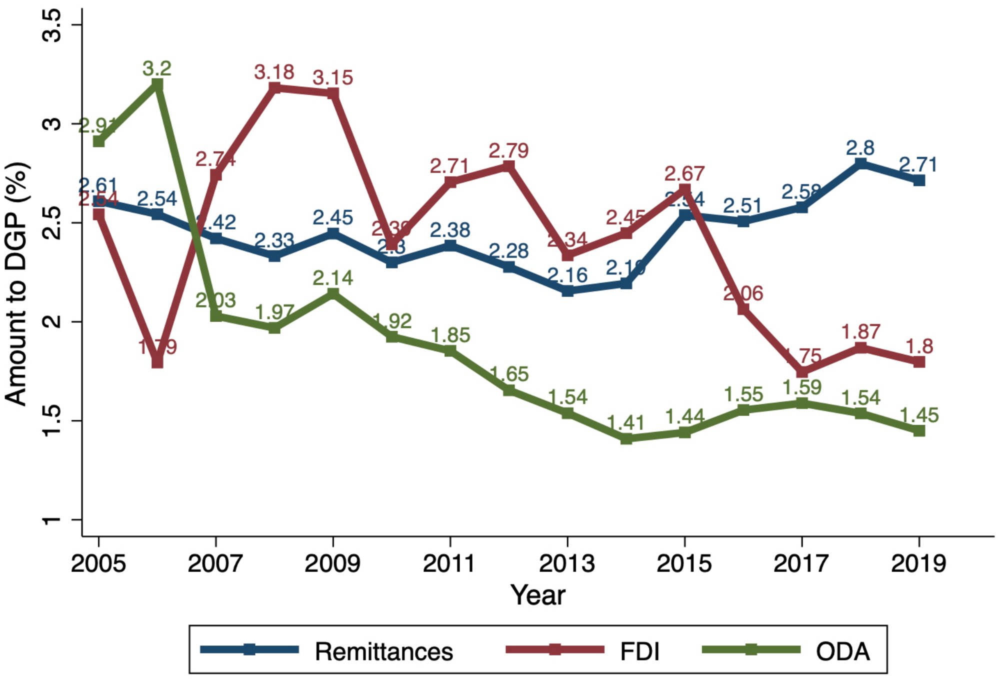
Source : Authors using WDI data

Figure 4.5: Remittances flows, Foreign Direct Investments and official development assistance to Sub-Saharan Africa



Source : Authors using WDI and OECD data

Figure 4.6: Remittances, Foreign Direct Investments and Official Development Assistance to GDP in Sub-Saharan Africa



Source : Authors using WDI and OECD data

Figure 4.7: Remittances flows, remittances prices and Foreign-born employment rate in OECD countries

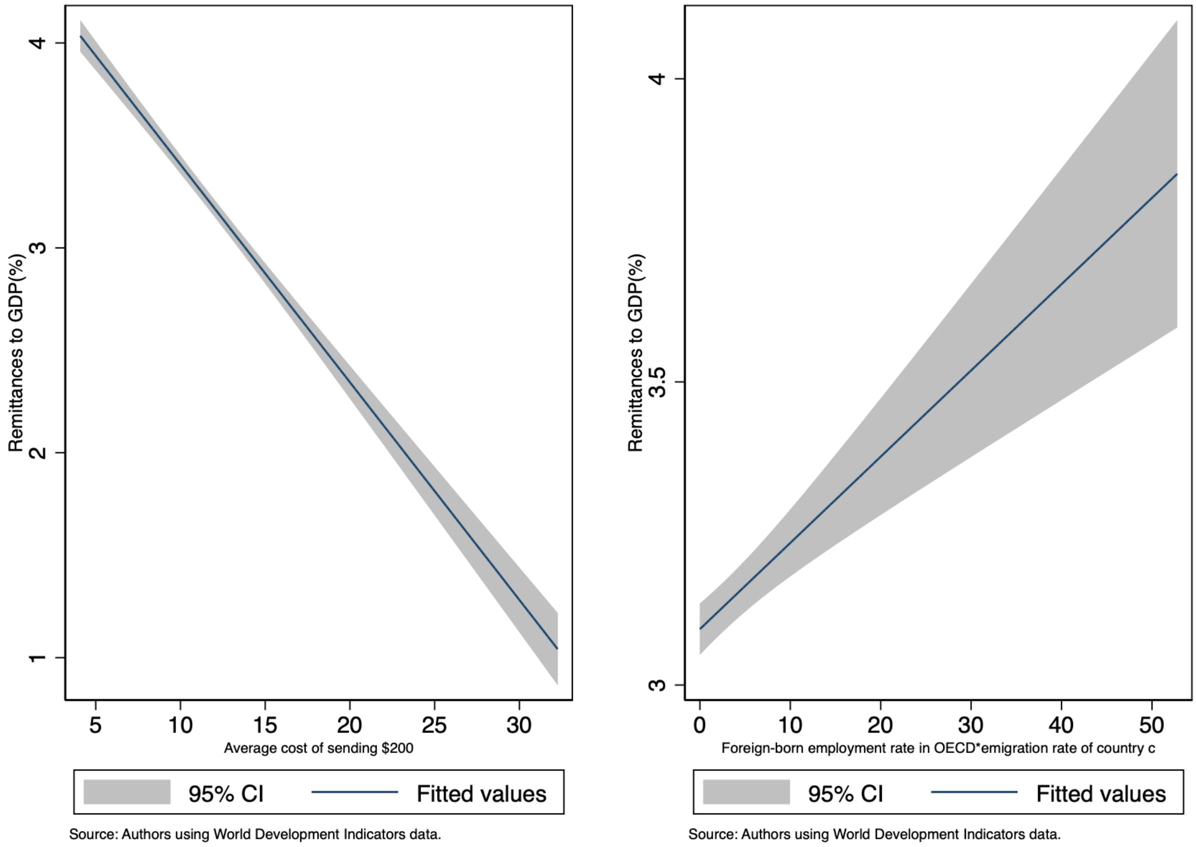


Table 4.1: Total firms, manufacturing firms and non-manufacturing firms by country and year

Country	Year	Total	Manufacturing	Non-manufacturing
Angola	2006	425	213	212
Angola	2010	360	78	282
Burundi	2006	270	102	168
Burundi	2014	157	60	97
Botswana	2006	342	114	228
Botswana	2010	268	85	183
Burkina Faso	2009	394	95	299
Benin	2009	150	72	78
Benin	2016	150	70	80
Cameroon	2009	363	106	257
Cameroon	2016	361	102	259
Chad	2009	150	60	90
Chad	2018	153	74	79
Ethiopia	2011	644	321	323
Ethiopia	2015	848	383	465
Gabon	2009	179	.	179
Ghana	2007	494	292	202
Ghana	2013	720	377	343
Guinea	2006	223	135	88
Guinea	2016	150	27	123
Guinea-Bissau	2006	159	50	109
Kenya	2007	657	396	261
Kenya	2013	781	414	367
Kenya	2018	1,001	455	546
Lesotho	2009	151	.	151
Lesotho	2016	150	76	74
Liberia	2009	150	.	150
Liberia	2017	151	75	76
Madagascar	2009	445	204	241
Madagascar	2013	532	.	532
Malawi	2009	150	71	79
Malawi	2014	523	197	326
Mali	2007	490	301	189
Mali	2010	360	160	200
Mali	2016	185	99	86
Mauritania	2006	237	80	157
Mauritania	2014	150	52	98
Mauritius	2009	398	216	182
Mozambique	2007	479	341	138
Mozambique	2018	601	287	314
Namibia	2006	329	106	223
Namibia	2014	580	181	399
Nigeria	2007	1,891	948	943
Nigeria	2014	2,676	1,427	1,249
Rwanda	2006	212	59	153
Rwanda	2011	241	81	160
Rwanda	2019	360	120	240
Senegal	2007	506	259	247
Senegal	2014	601	249	352
Sierra Leone	2009	150	.	150
Sierra Leone	2017	152	77	75
South Africa	2007	937	680	257
South Africa	2020	937	680	257
Sudan	2014	662	82	580
Tanzania	2006	419	273	146
Tanzania	2013	813	440	373
Togo	2009	155	35	120
Togo	2016	150	45	105
Uganda	2006	563	307	256
Uganda	2013	762	378	384
Zambia	2007	484	304	180
Zambia	2013	720	364	356
Zambia	2019	601	180	421
Zimbabwe	2011	599	376	223
Zimbabwe	2016	600	289	311

Table 4.2: Number of firms and share of each industry in the total sample by sector

Industries	Code	Number of firms	Percent
Manufacturing sector		15,223	100.00
Manufacture of food products and beverages	15	4,017	26.39
Manufacture of tobacco products	16	33	0.22
Manufacture of textiles	17	543	3.57
Manufacture of wearing apparel; dressing and dyeing of fur	18	2,029	13.33
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	19	292	1.92
Manufacture of wood and of products of wood and cork, except furniture	20	694	4.56
Manufacture of paper and paper products	21	187	1.23
Publishing, printing and reproduction of recorded media	22	1,030	6.77
Manufacture of coke, refined petroleum products and nuclear fuel	23	58	0.38
Manufacture of chemicals and chemical products	24	858	5.64
Manufacture of rubber and plastics products	25	543	3.57
Manufacture of basic metals	26	774	5.08
Manufacture of other non-metallic mineral products	27	318	2.09
Manufacture of fabricated metal products, except machinery and equipment	28	1,335	8.77
Manufacture of machinery and equipment n.e.c.	29	322	2.12
Manufacture of office, accounting and computing machinery	30	5	0.03
Manufacture of electrical machinery and apparatus n.e.c.	31	199	1.31
Manufacture of radio, television and communication equipment and apparatus	32	30	0.20
Manufacture of medical, precision and optical instruments, watches and clocks	33	24	0.16
Manufacture of motor vehicles, trailers and semi-trailers	34	111	0.73
Manufacture of other transport equipment	35	44	0.29
Manufacture of furniture; manufacturing n.e.c	36	1,750	11.50
Recycling	37	27	0.18
Non-manufacturing sector		18,787	100.00
Other Industries	4	3	0.02
Mining and quarrying	10	2	0.01
Collection, purification and distribution of water	40	2	0.01
Construction	45	1,252	6.66
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	50	13,641	72.61
Hotels and restaurants	55	2,274	12.10
Transport, storage and communications	60	1,197	6.37
Financial intermediation	65	2	0.01
Real estate, renting and business activities	70	410	2.18
Other community, social and personal service activities	90	4	0.02

Table 4.3: Descriptive statistics of the main variables

	All				Manufacture				Non-manufacture			
	Mean.	Sd	Min	Max	Mean.	Sd	Min	Max	Mean.	Sd	Min	Max
Firms variables												
Share owned by nationals	81.84	36.16	0.00	100.00	82.91	34.96	0.00	100.00	81.00	37.04	0.00	100.00
Number of permanent full-time employees	54.85	438.71	0.00	64000	70.88	265.52	0.00	8000	42.22	536.82	0.00	64000
Firm sales(log)	6.42	3.93	0.00	23.72	6.74	4.11	0.00	23.72	6.16	3.76	0.00	21.87
Firm sales (log)$_{t-3}$	5.20	4.30	0.00	26.27	5.62	4.48	0.00	26.27	4.88	4.11	0.00	22.45
Female Ownership	0.08	0.27	0.00	1.00	0.06	0.24	0.00	1.00	0.09	0.29	0.00	1.00
Location (= large city)	0.44	0.50	0.00	1.00	0.42	0.49	0.00	1.00	0.46	0.50	0.00	1.00
Transport obstacle	0.23	0.42	0.00	1.00	0.24	0.42	0.00	1.00	0.22	0.42	0.00	1.00
Small-sized firms	0.60	0.49	0.00	1.00	0.53	0.50	0.00	1.00	0.66	0.47	0.00	1.00
Medium-sized firm	0.28	0.45	0.00	1.00	0.32	0.46	0.00	1.00	0.26	0.44	0.00	1.00
Large size firm	0.11	0.32	0.00	1.00	0.16	0.36	0.00	1.00	0.08	0.27	0.00	1.00
Macroeconomic variables												
Remittances to GDP$_{t-1}$	3.13	3.78	0.00	32.59	3.19	3.35	0.00	17.70	3.08	4.09	0.00	32.59
Remittances per capita$_{t-1}$	42.73	52.86	0.01	322.42	44.92	52.01	0.01	322.42	41.01	53.46	0.01	322.42
Trade (% of GDP)$_{t-1}$	61.31	25.89	27.74	179.12	59.51	22.51	27.74	129.72	62.72	28.18	27.74	179.12
Unemployment rate$_{t-1}$	7.42	7.52	0.51	28.47	7.08	7.25	0.51	28.47	7.69	7.71	0.51	28.47
Time to start business$_{t-1}$	40.13	32.66	4.00	259.50	40.42	30.73	4.00	259.50	39.91	34.09	4.00	259.50
Real exchange rate$_{t-1}$	0.41	0.09	0.19	0.63	0.41	0.09	0.19	0.62	0.41	0.09	0.19	0.63
Domestic credit to private$_{t-1}$	24.72	32.15	1.20	156.98	26.17	35.10	1.20	156.98	23.59	29.58	1.20	156.98
Political stability index$_{t-1}$	-0.74	0.92	-2.19	1.06	-0.75	0.93	-2.19	1.06	-0.73	0.91	-2.19	1.06
Corruption index$_{t-1}$	34.15	17.87	0.00	83.70	32.56	16.66	0.00	83.70	35.39	18.66	0.00	83.70
Number of power outages (log)$_{t-1}$	2.29	0.64	0.71	3.49	2.30	0.67	0.71	3.49	2.29	0.63	0.71	3.49
Remittances prices$_{t-1}$	11.81	4.93	4.09	32.26	11.82	4.49	4.09	32.26	11.81	5.25	4.09	32.26
Foreign-born employment rate*migration rate$_{t-1}$	2.45	8.01	0.01	52.79	2.27	7.63	0.01	52.79	2.60	8.30	0.01	52.79
N	34645				15223				19422			

Table 4.4: Effect of international remittances on the share of the business owned by nationals

	Dependent variable : Share of the business owned by nationals (%)					
	Ordinary least squares model			Fixed-effects model		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture
Remittances to GDP$_{t-1}$	0.556***	0.680***	0.538***	-0.012	0.885*	0.146
	(0.060)	(0.094)	(0.076)	(0.196)	(0.456)	(0.249)
Trade (% of GDP)$_{t-1}$	0.015	-0.027	0.031**	-0.115**	-0.310***	-0.098
	(0.011)	(0.019)	(0.013)	(0.054)	(0.093)	(0.073)
Unemployment rate$_{t-1}$	-0.841***	-0.437***	-0.979***	-0.934**	-0.475	-1.000*
	(0.051)	(0.085)	(0.064)	(0.387)	(0.662)	(0.541)
Time to start business$_{t-1}$	0.050***	0.030***	0.063***	0.116***	0.012	0.154***
	(0.006)	(0.011)	(0.008)	(0.028)	(0.044)	(0.037)
Real exchange rate$_{t-1}$	-5.661*	-21.150***	-1.430	-34.571**	-26.336	-37.627*
	(3.190)	(4.973)	(4.262)	(15.701)	(25.359)	(21.061)
Domestic credit to private$_{t-1}$	0.335***	0.211***	0.388***	0.066	-0.052	0.439**
	(0.011)	(0.021)	(0.014)	(0.170)	(0.321)	(0.214)
Political stability index$_{t-1}$	2.285***	1.721***	2.082***	3.091**	7.254***	-1.205
	(0.318)	(0.521)	(0.407)	(1.455)	(2.533)	(1.973)
Corruption index$_{t-1}$	-0.266***	-0.189***	-0.290***	-0.140***	-0.009	-0.195***
	(0.014)	(0.023)	(0.018)	(0.033)	(0.057)	(0.043)
Transport obstacle$_{t-1}$	0.532	0.492	0.508	-0.340	-0.053	-0.576
	(0.473)	(0.687)	(0.651)	(0.470)	(0.678)	(0.652)
Number of power outages (log)$_{t-1}$	8.474***	6.255***	8.912***	-0.220	-0.023	0.344
	(0.483)	(0.809)	(0.617)	(1.649)	(3.260)	(2.200)
Female Ownership	6.518***	4.764***	7.192***	7.429***	6.393***	7.742***
	(0.670)	(1.158)	(0.823)	(0.696)	(1.178)	(0.861)
Location (= large city)	-0.972**	-0.728	-0.889	-1.890***	-0.755	-2.919***
	(0.424)	(0.658)	(0.560)	(0.507)	(0.794)	(0.667)
Large size firm	-18.540***	-18.494***	-19.009***	-16.427***	-16.839***	-15.609***
	(0.727)	(0.946)	(1.149)	(0.732)	(0.941)	(1.172)
GDP per capita$_{t-1}$	-0.002***	-0.001**	-0.002***	-0.011***	-0.010***	-0.007***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.003)	(0.002)
Domestic investment$_{t-1}$	-0.118***	0.015	-0.194***	0.129	0.252	0.189
	(0.026)	(0.041)	(0.034)	(0.110)	(0.193)	(0.144)
Observation	32998	14524	18474	32375	14524	17851
F-stats	192.952	60.868	151.509	58.036	31.597	27.971
R^2	0.098	0.070	0.122	0.148	0.134	0.167
Industry fixed effect				Yes	Yes	Yes
Country fixed effect				Yes	Yes	Yes
Year fixed effect				Yes	Yes	Yes

Notes : Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.5: First stage results

	Dependent variable : International remittances to GDP (%)								
	Instrumental variable approach with fixed effects								
	All			Manufacture			Non-manufacture		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Trade (% of GDP)$_{t-1}$	-0.039***	-0.029***	-0.048***	0.045***	0.055***	0.043***	-0.052***	-0.041***	-0.064***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Unemployment rate$_{t-1}$	0.677***	0.545***	0.607***	0.574***	0.405***	0.755***	0.716***	0.581***	0.651***
	(0.027)	(0.028)	(0.027)	(0.017)	(0.017)	(0.025)	(0.039)	(0.042)	(0.039)
Time to start business$_{t-1}$	-0.040***	-0.036***	-0.033***	-0.038***	-0.028***	-0.036***	-0.038***	-0.035***	-0.031***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Real exchange rate$_{t-1}$	-19.810***	-16.415***	-18.587***	-14.586***	-10.179***	-16.041***	-18.860***	-15.665***	-18.370***
	(1.088)	(1.104)	(1.026)	(0.874)	(0.641)	(0.563)	(1.546)	(1.591)	(1.440)
Domestic credit to private$_{t-1}$	-0.058***	-0.157***	-0.153***	-0.146***	-0.295***	-0.301***	-0.039***	-0.123***	-0.114***
	(0.008)	(0.011)	(0.011)	(0.011)	(0.010)	(0.010)	(0.010)	(0.013)	(0.013)
Political stability index$_{t-1}$	0.114***	0.802***	0.383***	0.702***	1.327***	1.271***	-0.001	0.618***	0.079
	(0.035)	(0.043)	(0.056)	(0.052)	(0.057)	(0.056)	(0.051)	(0.062)	(0.085)
Corruption index$_{t-1}$	0.047***	0.049***	0.057***	0.035***	0.038***	0.048***	0.039***	0.040***	0.049***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Transport obstacle$_{t-1}$	0.067***	0.062***	0.055***	0.045***	0.015*	0.011	0.076***	0.085***	0.071***
	(0.014)	(0.013)	(0.013)	(0.009)	(0.008)	(0.007)	(0.020)	(0.020)	(0.020)
Number of power outages (log)$_{t-1}$	-0.714***	-0.855***	-0.853***	-1.000***	-1.430***	0.183	-0.673***	-0.782***	-0.814***
	(0.060)	(0.062)	(0.062)	(0.093)	(0.089)	(0.161)	(0.075)	(0.075)	(0.074)
Female Ownership	-0.043**	-0.026	-0.011	0.004	0.039***	0.055***	-0.023	-0.011	0.003
	(0.022)	(0.021)	(0.022)	(0.016)	(0.013)	(0.014)	(0.029)	(0.029)	(0.029)
Location (= large city)	0.106***	0.110***	0.096***	0.033***	0.015*	0.009	0.102***	0.109***	0.092***
	(0.013)	(0.013)	(0.013)	(0.010)	(0.008)	(0.007)	(0.019)	(0.018)	(0.018)
Large size firm	-0.027	-0.019	-0.018	-0.038***	-0.022***	-0.026***	0.013	0.015	0.023
	(0.017)	(0.017)	(0.017)	(0.010)	(0.008)	(0.008)	(0.031)	(0.030)	(0.030)
GDP per capita$_{t-1}$		-0.002***	-0.002***		-0.003***	-0.003***		-0.002***	-0.002***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Domestic investment$_{t-1}$			0.058***			0.132***			0.066***
			(0.004)			(0.005)			(0.006)
Instruments									
Remittances prices$_{t-1}$	-0.384***	-0.340***	-0.322***	-0.268***	-0.223***	-0.091***	-0.412***	-0.370***	-0.349***
	(0.005)	(0.007)	(0.007)	(0.008)	(0.009)	(0.014)	(0.008)	(0.010)	(0.009)
Foreign-born employment rate*migration rate$_{t-1}$	0.139***	0.138***	0.149***	0.193***	0.192***	0.269***	0.127***	0.124***	0.136***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.007)	(0.005)	(0.005)	(0.004)
Observation	31203	31203	31203	14128	14128	14128	17075	17075	17075
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.6: Effect of international remittances on the share of the business owned by nationals

	Dependent variable : Share of the business owned by nationals (%)								
	Instrumental variable approach with fixed effects								
	All			Manufacture			Non-manufacture		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Remittances to GDP$_{t-1}$	1.103***	0.944**	0.938**	1.414**	1.297**	1.402**	0.427	0.279	0.146
	(0.377)	(0.394)	(0.396)	(0.569)	(0.592)	(0.586)	(0.527)	(0.557)	(0.567)
Trade (% of GDP)$_{t-1}$	-0.101**	-0.057	-0.047	-0.311***	-0.255**	-0.314***	-0.047	-0.009	-0.054
	(0.048)	(0.049)	(0.068)	(0.094)	(0.099)	(0.119)	(0.063)	(0.064)	(0.094)
Unemployment rate$_{t-1}$	-0.955**	-1.392***	-1.414***	-0.432	-0.852	-0.619	-1.028*	-1.427**	-1.290**
	(0.408)	(0.406)	(0.432)	(0.631)	(0.647)	(0.718)	(0.574)	(0.574)	(0.626)
Time to start business$_{t-1}$	0.118***	0.137***	0.135***	-0.025	0.006	0.015	0.143***	0.155***	0.161***
	(0.027)	(0.027)	(0.029)	(0.042)	(0.043)	(0.044)	(0.038)	(0.038)	(0.039)
Real exchange rate$_{t-1}$	-34.006**	-16.029	-14.702	-36.581	-15.570	-22.346	-33.275	-18.817	-25.624
	(16.856)	(17.114)	(18.611)	(26.423)	(28.128)	(29.579)	(22.688)	(23.020)	(25.870)
Domestic credit to private$_{t-1}$	0.607***	0.238	0.233	0.493*	0.067	0.121	0.760***	0.477**	0.482**
	(0.158)	(0.181)	(0.181)	(0.283)	(0.335)	(0.333)	(0.199)	(0.227)	(0.226)
Political stability index$_{t-1}$	0.343	3.861***	4.069**	4.607*	7.859***	7.239**	-2.666	0.257	-0.560
	(1.286)	(1.493)	(1.741)	(2.479)	(2.771)	(2.878)	(1.732)	(2.017)	(2.440)
Corruption index$_{t-1}$	-0.202***	-0.196***	-0.200***	-0.054	-0.054	-0.033	-0.251***	-0.248***	-0.227***
	(0.035)	(0.035)	(0.043)	(0.058)	(0.058)	(0.066)	(0.045)	(0.045)	(0.058)
Transport obstacle$_{t-1}$	-0.419	-0.432	-0.428	0.048	-0.051	-0.053	-0.739	-0.694	-0.716
	(0.479)	(0.478)	(0.479)	(0.689)	(0.689)	(0.689)	(0.667)	(0.667)	(0.669)
Number of power outages (log)$_{t-1}$	-0.595	-1.130	-1.027	0.573	-0.116	0.133	1.372	0.976	0.656
	(1.658)	(1.629)	(1.694)	(3.262)	(3.262)	(3.262)	(2.235)	(2.196)	(2.290)
Female Ownership	7.638***	7.723***	7.718***	6.619***	6.732***	6.765***	7.804***	7.870***	7.875***
	(0.698)	(0.698)	(0.698)	(1.186)	(1.183)	(1.184)	(0.861)	(0.862)	(0.863)
Location (= large city)	-2.193***	-2.200***	-2.199***	-0.772	-0.855	-0.841	-3.321***	-3.298***	-3.292***
	(0.517)	(0.516)	(0.516)	(0.809)	(0.810)	(0.810)	(0.677)	(0.677)	(0.677)
Large size firm	-16.489***	-16.452***	-16.451***	-16.956***	-16.901***	-16.915***	-15.624***	-15.604***	-15.593***
	(0.744)	(0.744)	(0.744)	(0.952)	(0.951)	(0.951)	(1.197)	(1.198)	(1.198)
GDP per capita$_{t-1}$		-0.009***	-0.009***		-0.009***	-0.009**		-0.007***	-0.007***
		(0.002)	(0.002)		(0.003)	(0.003)		(0.002)	(0.002)
Domestic investment$_{t-1}$			-0.027			0.182			0.116
			(0.132)			(0.220)			(0.180)
Observation	31203	31203	31203	14128	14128	14128	17075	17075	17075
F-stats	62.352	62.390	58.381	33.492	33.841	31.989	30.847	29.523	28.012
R^2	0.032	0.033	0.033	0.040	0.041	0.041	0.027	0.028	0.028
Kleibergen-Paap rk Wald F statistic	5026	2830	2559	6818	4516	7029	2021	1342	1194
Kleibergen-Paap rk LM statistic	6021	6021	5283	3223	3948	3876	2836	2549	2000
Chi-sq(2) P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.7: Effect of international remittances on firm sales

	Dependent variable : Total annual firm sales (log)					
	Ordinary least squares model			Fixed-effects model		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture
Remittances to GDP$_{t-1}$	-0.140***	-0.210***	-0.104***	-0.092***	-0.338***	-0.078***
	(0.005)	(0.007)	(0.005)	(0.013)	(0.032)	(0.015)
Trade (% of GDP)$_{t-1}$	0.013***	0.007***	0.015***	0.002	-0.007	0.013***
	(0.001)	(0.001)	(0.001)	(0.004)	(0.006)	(0.005)
Unemployment rate$_{t-1}$	0.027***	0.040***	0.012***	-0.414***	-0.662***	-0.426***
	(0.003)	(0.005)	(0.004)	(0.027)	(0.050)	(0.037)
Time to start business$_{t-1}$	-0.003***	-0.010***	-0.000	-0.000	0.006**	-0.000
	(0.000)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)
Real exchange rate$_{t-1}$	1.706***	3.367***	0.836***	13.910***	18.045***	13.910***
	(0.232)	(0.355)	(0.303)	(1.046)	(1.827)	(1.364)
Domestic credit to private$_{t-1}$	-0.005***	-0.004***	-0.007***	-0.004	-0.079***	-0.006
	(0.001)	(0.001)	(0.001)	(0.010)	(0.019)	(0.013)
Political stability index$_{t-1}$	0.199***	0.145***	0.239***	-0.597***	-1.469***	-0.284**
	(0.022)	(0.034)	(0.028)	(0.094)	(0.154)	(0.130)
Corruption index$_{t-1}$	-0.015***	-0.021***	-0.011***	-0.015***	-0.011***	-0.011***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)	(0.003)
Transport obstacle$_{t-1}$	0.115***	0.160***	0.062	0.009	-0.019	0.044
	(0.033)	(0.047)	(0.047)	(0.031)	(0.043)	(0.044)
Number of power outages (log)$_{t-1}$	0.190***	-0.032	0.310***	-0.882***	-2.153***	-0.788***
	(0.031)	(0.051)	(0.039)	(0.104)	(0.195)	(0.138)
Female Ownership	-0.469***	-0.467***	-0.453***	-0.187***	-0.133	-0.192***
	(0.051)	(0.088)	(0.063)	(0.049)	(0.082)	(0.062)
Location (= large city)	-0.326***	-0.601***	-0.178***	0.133***	0.028	0.192***
	(0.031)	(0.047)	(0.041)	(0.034)	(0.051)	(0.046)
Large size firm	0.967***	0.996***	0.894***	1.267***	1.315***	1.263***
	(0.052)	(0.068)	(0.082)	(0.051)	(0.067)	(0.082)
Firm sales$_{t-3}$	0.627***	0.613***	0.623***	0.502***	0.475***	0.513***
	(0.005)	(0.008)	(0.006)	(0.006)	(0.009)	(0.007)
Domestic investment$_{t-1}$	0.021***	0.019***	0.019***	0.046***	0.058***	0.018*
	(0.002)	(0.003)	(0.003)	(0.007)	(0.012)	(0.010)
GDP per capita$_{t-1}$	-0.000***	-0.000***	-0.000	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observation	33626	14827	18799	33000	14827	18173
F-stats	3444.505	2485.274	1425.421	1275.050	657.237	684.665
R^2	0.607	0.667	0.558	0.691	0.742	0.645
Industry fixed effect				Yes	Yes	Yes
Country fixed effect				Yes	Yes	Yes
Year fixed effect				Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.8: Effect of international remittances on firm sales

	Dependent variable : Total annual firm sales (log)								
	Instrumental variable approach with fixed effects								
	All			Manufacture			Non-manufacture		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Remittances to GDP$_{t-1}$	0.086***	0.081***	0.083***	-0.102***	-0.120***	-0.129***	0.121***	0.115***	0.125***
	(0.023)	(0.024)	(0.024)	(0.037)	(0.038)	(0.038)	(0.032)	(0.034)	(0.035)
Trade (% of GDP)$_{t-1}$	0.016***	0.016***	-0.002	-0.006	0.000	-0.015*	0.018***	0.018***	0.009
	(0.003)	(0.003)	(0.004)	(0.007)	(0.007)	(0.008)	(0.004)	(0.004)	(0.006)
Unemployment rate$_{t-1}$	-0.448***	-0.456***	-0.416***	-0.627***	-0.673***	-0.613***	-0.455***	-0.458***	-0.440***
	(0.028)	(0.029)	(0.029)	(0.050)	(0.052)	(0.054)	(0.039)	(0.039)	(0.041)
Time to start business$_{t-1}$	-0.001	-0.001	0.003**	0.000	0.003	0.006**	0.002	0.002	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
Real exchange rate$_{t-1}$	15.214***	15.546***	13.198***	15.662***	17.916***	16.373***	14.755***	14.888***	13.734***
	(1.121)	(1.132)	(1.169)	(2.095)	(2.195)	(2.193)	(1.497)	(1.495)	(1.592)
Domestic credit to private$_{t-1}$	-0.007	-0.014	-0.007	-0.017	-0.062***	-0.053***	-0.012	-0.015	-0.010
	(0.010)	(0.011)	(0.011)	(0.018)	(0.020)	(0.020)	(0.013)	(0.014)	(0.014)
Political stability index$_{t-1}$	-0.748***	-0.682***	-1.044***	-1.770***	-1.434***	-1.570***	-0.685***	-0.647***	-0.852***
	(0.078)	(0.093)	(0.109)	(0.160)	(0.168)	(0.175)	(0.106)	(0.128)	(0.156)
Corruption index$_{t-1}$	-0.032***	-0.032***	-0.025***	-0.027***	-0.027***	-0.020***	-0.024***	-0.024***	-0.021***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Transport obstacle$_{t-1}$	-0.005	-0.005	-0.013	-0.002	-0.012	-0.014	0.005	0.005	-0.001
	(0.032)	(0.032)	(0.032)	(0.044)	(0.044)	(0.044)	(0.045)	(0.045)	(0.045)
Number of power outages (log)$_{t-1}$	-0.886***	-0.895***	-1.070***	-1.970***	-2.047***	-2.001***	-0.928***	-0.928***	-1.032***
	(0.105)	(0.104)	(0.107)	(0.196)	(0.197)	(0.196)	(0.136)	(0.134)	(0.142)
Female Ownership	-0.178***	-0.177***	-0.170***	-0.154*	-0.144*	-0.134	-0.178***	-0.177***	-0.175***
	(0.049)	(0.049)	(0.049)	(0.083)	(0.083)	(0.083)	(0.062)	(0.061)	(0.061)
Location (= large city)	0.160***	0.160***	0.159***	0.073	0.065	0.065	0.204***	0.205***	0.204***
	(0.034)	(0.034)	(0.034)	(0.052)	(0.052)	(0.052)	(0.046)	(0.046)	(0.046)
Large size firm	1.244***	1.246***	1.248***	1.272***	1.282***	1.280***	1.235***	1.236***	1.239***
	(0.052)	(0.052)	(0.052)	(0.068)	(0.068)	(0.068)	(0.083)	(0.083)	(0.084)
Firm sales$_{t-3}$	0.506***	0.506***	0.505***	0.486***	0.485***	0.484***	0.515***	0.514***	0.514***
	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)	(0.009)	(0.007)	(0.008)	(0.008)
GDP per capita$_{t-1}$		-0.000	-0.000		-0.001***	-0.001***		-0.000	-0.000
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Domestic investment$_{t-1}$			0.049***			0.054***			0.023**
			(0.008)			(0.013)			(0.012)
Observation	31804	31804	31804	14422	14422	14422	17382	17382	17382
F-stats	1320.605	1249.179	1200.001	678.130	636.748	609.873	688.693	652.252	617.881
R^2	0.463	0.463	0.464	0.491	0.492	0.493	0.440	0.440	0.440
Kleibergen-Paap rk Wald F statistic	5030	2854	2563	6967	4555	7115	2105	1452	1338
Kleibergen-Paap rk LM statistic	5962	5968	5246	3153	3909	3832	2876	2547	2112
Chi-sq(2) P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.9: Effect of international remittances on the number of permanent and full-time employees

	Dependent variable : Number of full-time employees(log)					
	Ordinary least squares model			Fixed-effects model		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture
Remittances to GDP$_{t-1}$	0.007***	0.004*	0.007***	0.006	-0.001	0.011**
	(0.001)	(0.002)	(0.002)	(0.004)	(0.010)	(0.005)
Trade (% of GDP)$_{t-1}$	-0.001***	-0.001*	-0.001***	-0.000	0.002	-0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)
Unemployment rate$_{t-1}$	-0.000	0.006***	0.001	-0.016**	0.013	-0.015
	(0.001)	(0.002)	(0.001)	(0.008)	(0.014)	(0.010)
Time to start business$_{t-1}$	-0.000	0.000	-0.001***	-0.002***	-0.003***	-0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Real exchange rate$_{t-1}$	-0.374***	-0.710***	-0.333***	0.257	-0.408	0.445
	(0.064)	(0.102)	(0.084)	(0.320)	(0.533)	(0.421)
Domestic credit to private$_{t-1}$	0.002***	0.001**	0.002***	0.007**	0.006	0.008*
	(0.000)	(0.000)	(0.000)	(0.003)	(0.007)	(0.004)
Political stability index$_{t-1}$	-0.038***	-0.081***	-0.019**	0.039	0.098*	0.104***
	(0.007)	(0.011)	(0.008)	(0.030)	(0.057)	(0.039)
Corruption index$_{t-1}$	-0.001*	-0.001	0.001	0.002***	0.001	0.003***
	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Transport obstacle$_{t-1}$	0.010	0.011	-0.006	0.010	0.004	0.012
	(0.010)	(0.016)	(0.014)	(0.010)	(0.015)	(0.014)
Number of power outages (log)$_{t-1}$	-0.077***	-0.124***	-0.048***	0.059*	0.134*	0.085*
	(0.010)	(0.017)	(0.012)	(0.034)	(0.072)	(0.045)
Female Ownership	-0.219***	-0.208***	-0.201***	-0.225***	-0.210***	-0.237***
	(0.016)	(0.027)	(0.019)	(0.016)	(0.027)	(0.019)
Location (= large city)	0.143***	0.150***	0.150***	0.134***	0.176***	0.110***
	(0.010)	(0.015)	(0.012)	(0.011)	(0.017)	(0.015)
Large size firm	2.629***	2.557***	2.625***	2.457***	2.417***	2.483***
	(0.015)	(0.019)	(0.023)	(0.015)	(0.020)	(0.024)
GDP per capita$_{t-1}$	0.000***	0.000***	0.000***	0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Domestic investment$_{t-1}$	0.004***	0.004***	0.004***	0.003	0.003	0.006**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.004)	(0.003)
Observation	33206	14683	18523	32593	14683	17910
F-stats	2403.944	1365.958	964.030	1829.838	1028.942	774.076
R^2	0.556	0.600	0.496	0.588	0.636	0.507
Industry fixed effect				Yes	Yes	Yes
Country fixed effect				Yes	Yes	Yes
Year fixed effect				Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.10: Effect of international remittances on the number of permanent and full-time employees

	Dependent variable : Number of full-time employees(log)								
	Instrumental variable approach with fixed effects								
	All			Manufacture			Non-manufacture		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Remittances to GDP$_{t-1}$	0.051***	0.055***	0.053***	0.040***	0.041***	0.037***	0.079***	0.083***	0.084***
	(0.008)	(0.009)	(0.009)	(0.013)	(0.013)	(0.013)	(0.011)	(0.012)	(0.012)
Trade (% of GDP)$_{t-1}$	0.001	0.000	0.001	0.002	0.001	0.002	0.003**	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
Unemployment rate$_{t-1}$	-0.038***	-0.030***	-0.031***	0.004	0.012	0.010	-0.056***	-0.046***	-0.048***
	(0.008)	(0.008)	(0.009)	(0.013)	(0.014)	(0.015)	(0.012)	(0.012)	(0.013)
Time to start business$_{t-1}$	-0.001	-0.001**	-0.001**	-0.002***	-0.003***	-0.003***	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Real exchange rate$_{t-1}$	1.048***	0.701**	0.788**	-0.042	-0.415	-0.348	1.848***	1.480***	1.610***
	(0.345)	(0.350)	(0.375)	(0.554)	(0.585)	(0.599)	(0.465)	(0.472)	(0.518)
Domestic credit to private$_{t-1}$	0.007**	0.014***	0.014***	0.007	0.015**	0.014**	0.010**	0.018***	0.017***
	(0.003)	(0.004)	(0.004)	(0.006)	(0.007)	(0.007)	(0.004)	(0.005)	(0.005)
Political stability index$_{t-1}$	0.101***	0.031	0.046	0.140**	0.082	0.089	0.194***	0.115***	0.133***
	(0.026)	(0.031)	(0.036)	(0.056)	(0.062)	(0.063)	(0.034)	(0.041)	(0.049)
Corruption index$_{t-1}$	0.001	0.001	0.000	-0.000	-0.000	-0.000	0.000	0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Transport obstacle$_{t-1}$	0.006	0.006	0.006	0.003	0.005	0.005	0.005	0.004	0.004
	(0.010)	(0.010)	(0.010)	(0.016)	(0.016)	(0.016)	(0.014)	(0.014)	(0.014)
Number of power outages (log)$_{t-1}$	-0.001	0.009	0.017	0.143**	0.155**	0.151**	-0.002	0.008	0.017
	(0.035)	(0.034)	(0.035)	(0.072)	(0.073)	(0.073)	(0.046)	(0.045)	(0.047)
Female Ownership	-0.221***	-0.223***	-0.223***	-0.215***	-0.217***	-0.217***	-0.230***	-0.232***	-0.232***
	(0.016)	(0.016)	(0.016)	(0.027)	(0.027)	(0.027)	(0.020)	(0.020)	(0.020)
Location (= large city)	0.130***	0.130***	0.131***	0.178***	0.179***	0.179***	0.105***	0.104***	0.104***
	(0.011)	(0.011)	(0.011)	(0.018)	(0.018)	(0.018)	(0.015)	(0.015)	(0.015)
Large size firm	2.454***	2.454***	2.454***	2.417***	2.416***	2.416***	2.471***	2.471***	2.471***
	(0.016)	(0.016)	(0.016)	(0.020)	(0.020)	(0.020)	(0.025)	(0.025)	(0.025)
GDP per capita$_{t-1}$		0.000***	0.000***		0.000**	0.000**		0.000***	0.000***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Domestic investment$_{t-1}$			-0.002			-0.000			-0.002
			(0.003)			(0.005)			(0.004)
Observation	31404	31404	31404	14279	14279	14279	17125	17125	17125
F-stats	2020.902	1876.447	1751.489	1157.237	1074.934	1003.384	838.806	778.919	726.810
R^2	0.511	0.511	0.511	0.562	0.563	0.563	0.443	0.443	0.443
Kleibergen-Paap rk Wald F statistic	4930	2781	2485	6827	4490	6971	2060	1410	1280
Kleibergen-Paap rk LM statistic	5969	5906	5213	3235	3922	3856	2888	2535	2101
Chi-sq(2) P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.11: Effect of international remittances on the share of the firm owned by nationals, excluding the most financially developed countries

	Dependent variable : Share of the business owned by nationals (%)		
	Instrumental variable approach with fixed effects		
	(1)	(2)	(3)
	All	Manufacture	Non-Manufacture
Remittances to GDP$_{t-1}$	0.571	1.891**	-0.012
	(0.350)	(0.888)	(0.467)
Controls	Yes	Yes	Yes
Observation	23281	10580	12701
F-stats	49.760	27.574	23.006
R^2	0.034	0.044	0.028
Kleibergen-Paap rk Wald F statistic	18449	41935	9216
Kleibergen-Paap rk LM statistic	4554	1550	2729
Chi-sq(2) P-value	0.000	0.000	0.000
Industry fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. The 25% of countries with the highest domestic credit to the private sector relative to GDP are excluded. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.12: Effect of international remittances on the share of the firm owned by nationals, excluding the least financially developed countries

	Dependent variable : Share of the business owned by nationals (%)		
	Instrumental variable approach with fixed effects		
	(1)	(2)	(3)
	All	Manufacture	Non-Manufacture
Remittances to GDP$_{t-1}$	-0.280	0.800	-0.795
	(0.521)	(1.420)	(0.658)
Controls	Yes	Yes	Yes
Observation	23634	10714	12920
F-stats	48.951	28.619	20.259
R^2	0.032	0.043	0.023
Kleibergen-Paap rk Wald F statistic	3153	17892	1824
Kleibergen-Paap rk LM statistic	1794	1646	1077
Chi-sq(2) P-value	0.000	0.000	0.000
Industry fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. The 25% of countries with the lowest domestic credit to the private sector relative to GDP are excluded. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.13: Effect of international remittances on the share of the firm owned by nationals, sales and employment, excluding top receivers

	Instrumental variable approach with fixed effects								
	Share			Sales			Employment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	Manufacture	Non-manufacture	All	Manufacture	Non-manufacture	All	Manufacture	Non-manufacture
Remittances to GDP$_{t-1}$	0.925**	1.396**	0.036	0.068**	0.005	0.098**	0.061***	0.068***	0.095***
	(0.438)	(0.674)	(0.639)	(0.027)	(0.041)	(0.040)	(0.010)	(0.015)	(0.014)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	29492	13402	16090	30075	13695	16380	29686	13555	16131
F-stats	51.657	27.579	25.468	1211.573	585.554	622.992	1682.556	963.204	695.981
R^2	0.032	0.038	0.027	0.471	0.494	0.449	0.511	0.562	0.448
Kleibergen-Paap rk Wald F statistic	15088	7214	5714	15299	7333	5769	15048	7248	5716
Kleibergen-Paap rk LM statistic	7865	2224	2817	7835	2225	2806	7859	2228	2823
Chi-sq(2) P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. We consider as top receivers those countries for which remittances represent at least 10% of GDP.

Table 4.14: Effect of international remittances on the share of the firm owned by nationals, sales and employment, excluding natural resource-rich countries

	Instrumental variable approach with fixed effects								
	Share			Sales			Employment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	Manufacture	Non-manufacture	All	Manufacture	Non-manufacture	All	Manufacture	Non-manufacture
Remittances to GDP$_{t-1}$	1.124	2.913***	-0.724	0.647***	0.256***	0.752***	0.152***	0.098***	0.190***
	(0.831)	(1.122)	(1.167)	(0.050)	(0.065)	(0.072)	(0.018)	(0.025)	(0.025)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	28836	13061	15775	29422	13351	16071	29041	13208	15833
F-stats	47.465	27.126	23.953	1163.689	593.475	597.790	1580.192	928.333	635.632
R^2	0.031	0.038	0.025	0.452	0.490	0.427	0.507	0.564	0.434
Kleibergen-Paap rk Wald F statistic	1809	1979	754	2131	2149	925	2103	2080	920
Kleibergen-Paap rk LM statistic	1925	1724	843	2182	1809	990	2166	1763	987
Chi-sq(2) P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level Natural resource-rich countries are : Mozambique, Liberia, Mauritania, Sierra Leone, Gabon, Chad, Angola, Equatorial Guinea, Congo. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.15: Effect of international remittances on the share of the firm owned by nationals,sales and employment, by firm size

	Instrumental variable approach with fixed effects								
	Small (<20)			Medium (20-99)			Large (100 And Over)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture
	Panel A : Share of firms owned by nationals								
Remittances to GDP$_{t-1}$	1.308***	0.788	0.963	0.981	2.547**	-1.154	1.617	0.528	5.127
	(0.463)	(0.701)	(0.662)	(0.786)	(1.138)	(1.314)	(1.782)	(2.465)	(4.787)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Panel B : Total annual firm sales (log)								
Remittances to GDP$_{t-1}$	-0.045	-0.317***	0.042	0.209***	-0.057	0.193***	0.206**	-0.094	0.727**
	(0.029)	(0.047)	(0.041)	(0.045)	(0.072)	(0.071)	(0.099)	(0.133)	(0.306)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Panel C: Number of full-time employees(log)								
Remittances to GDP$_{t-1}$	0.029***	0.004	0.056***	0.038***	0.030*	0.056***	-0.049	-0.078*	-0.061
	(0.006)	(0.009)	(0.009)	(0.011)	(0.015)	(0.016)	(0.032)	(0.044)	(0.086)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observation	18889	7553	11336	8947	4466	4481	3561	2259	1301
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Small size firms are those that employ fewer than 20 people. Medium-sized firms use between 20 and 99 people, and large firms employ more than 100 people.

Table 4.16: Effect of international remittances per capita on the share of the business owned by nationals

	Dependent variable : Share of the business owned by nationals (%)								
	Ordinary least squares model			Fixed-effects model			Instrumental variable approach with fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture
Remittances per capita$_{t-1}$	0.047***	0.048***	0.047***	0.031	0.059	0.057**	0.114**	0.145**	0.080
	(0.005)	(0.007)	(0.006)	(0.021)	(0.041)	(0.028)	(0.047)	(0.060)	(0.070)
Trade (% of GDP)$_{t-1}$	0.029***	-0.004	0.043***	-0.114**	-0.291***	-0.088	-0.038	-0.315***	-0.033
	(0.011)	(0.019)	(0.013)	(0.054)	(0.091)	(0.073)	(0.068)	(0.120)	(0.094)
Unemployment rate$_{t-1}$	-0.838***	-0.439***	-0.978***	-1.086***	-0.857	-1.256**	-1.825***	-1.484**	-1.703**
	(0.050)	(0.085)	(0.064)	(0.398)	(0.690)	(0.555)	(0.480)	(0.752)	(0.709)
Time to start business$_{t-1}$	0.052***	0.031***	0.065***	0.116***	0.004	0.149***	0.115***	-0.004	0.156***
	(0.006)	(0.011)	(0.008)	(0.027)	(0.044)	(0.036)	(0.028)	(0.045)	(0.037)
Real exchange rate$_{t-1}$	-12.922***	-26.495***	-9.316**	-32.316**	-19.501	-33.010	-8.735	-12.024	-17.029
	(3.359)	(5.194)	(4.484)	(15.756)	(25.079)	(21.193)	(18.742)	(28.862)	(26.438)
Domestic credit to private$_{t-1}$	0.352***	0.234***	0.405***	0.103	-0.125	0.475**	0.264	0.116	0.552**
	(0.012)	(0.022)	(0.015)	(0.170)	(0.313)	(0.215)	(0.184)	(0.332)	(0.230)
Political stability index$_{t-1}$	2.530***	1.877***	2.363***	2.517*	6.613**	-1.914	3.091	4.808	-1.355
	(0.321)	(0.525)	(0.411)	(1.506)	(2.749)	(2.025)	(1.898)	(3.338)	(2.573)
Corruption index$_{t-1}$	-0.253***	-0.184***	-0.273***	-0.153***	-0.001	-0.214***	-0.212***	-0.035	-0.257***
	(0.014)	(0.023)	(0.018)	(0.033)	(0.057)	(0.044)	(0.044)	(0.066)	(0.060)
Transport obstacle$_{t-1}$	0.564	0.487	0.557	-0.353	-0.074	-0.608	-0.470	-0.082	-0.762
	(0.473)	(0.687)	(0.651)	(0.470)	(0.678)	(0.652)	(0.480)	(0.689)	(0.670)
Number of power outages (log)$_{t-1}$	8.501***	6.415***	8.985***	-0.013	-0.087	0.892	0.565	0.466	1.405
	(0.483)	(0.806)	(0.617)	(1.636)	(3.266)	(2.177)	(1.644)	(3.280)	(2.173)
Female Ownership	6.479***	4.715***	7.167***	7.426***	6.389***	7.725***	7.654***	6.735***	7.858***
	(0.670)	(1.157)	(0.824)	(0.696)	(1.178)	(0.861)	(0.698)	(1.184)	(0.863)
Location (= large city)	-0.715*	-0.554	-0.612	-1.881***	-0.773	-2.897***	-2.135***	-0.848	-3.279***
	(0.425)	(0.657)	(0.561)	(0.507)	(0.794)	(0.667)	(0.516)	(0.810)	(0.677)
Large size firm	-18.557***	-18.494***	-19.020***	-16.417***	-16.835***	-15.608***	-16.433***	-16.890***	-15.592***
	(0.727)	(0.947)	(1.150)	(0.732)	(0.941)	(1.173)	(0.744)	(0.952)	(1.198)
GDP per capita$_{t-1}$	-0.003***	-0.002***	-0.003***	-0.010***	-0.011***	-0.007***	-0.009***	-0.009***	-0.006***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Domestic investment$_{t-1}$	-0.114***	0.010	-0.187***	0.114	0.239	0.158	-0.047	0.128	0.056
	(0.026)	(0.041)	(0.034)	(0.110)	(0.194)	(0.144)	(0.132)	(0.220)	(0.183)
Observation	32998	14524	18474	32375	14524	17851	31203	14128	17075
F-stats	192.820	59.901	151.300	58.476	31.582	28.390	58.507	31.970	28.376
R^2	0.098	0.070	0.122	0.148	0.134	0.167	0.033	0.041	0.028
Kleibergen-Paap rk Wald F statistic							1432	2593	597
Kleibergen-Paap rk LM statistic							4102	2907	1462
Chi-sq(2) P-value							0.000	0.000	0.000
Industry fixed effect				Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect				Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect				Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.17: Effect of international remittances per capita on on firm sales

	Dependent variable : Total annual firm sales (log)								
	Ordinary least squares model			Fixed-effects model			Instrumental variable approach with fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture
Remittances per capita$_{t-1}$	-0.009***	-0.013***	-0.007***	-0.021***	-0.035***	-0.020***	0.004	-0.013***	0.004
	(0.000)	(0.001)	(0.000)	(0.001)	(0.003)	(0.002)	(0.003)	(0.004)	(0.005)
Trade (% of GDP)$_{t-1}$	0.008***	-0.001	0.012***	-0.000	-0.010	0.009*	-0.002	-0.014*	0.007
	(0.001)	(0.001)	(0.001)	(0.004)	(0.006)	(0.005)	(0.004)	(0.008)	(0.006)
Unemployment rate$_{t-1}$	0.022***	0.038***	0.008**	-0.329***	-0.458***	-0.342***	-0.421***	-0.533***	-0.424***
	(0.003)	(0.005)	(0.004)	(0.027)	(0.046)	(0.037)	(0.031)	(0.050)	(0.046)
Time to start business$_{t-1}$	-0.003***	-0.010***	-0.000	0.002	0.011***	0.002	0.002	0.008***	0.001
	(0.000)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)
Real exchange rate$_{t-1}$	3.060***	4.605***	2.020***	12.561***	15.295***	12.398***	13.176***	15.450***	13.041***
	(0.246)	(0.385)	(0.317)	(1.034)	(1.769)	(1.349)	(1.170)	(2.092)	(1.639)
Domestic credit to private$_{t-1}$	-0.008***	-0.010***	-0.009***	-0.017	-0.071***	-0.016	-0.013	-0.053***	-0.019
	(0.001)	(0.001)	(0.001)	(0.010)	(0.019)	(0.013)	(0.011)	(0.020)	(0.014)
Political stability index$_{t-1}$	0.162***	0.112***	0.201***	-0.352***	-0.938***	-0.073	-1.037***	-1.344***	-0.826***
	(0.022)	(0.035)	(0.028)	(0.096)	(0.168)	(0.133)	(0.117)	(0.202)	(0.162)
Corruption index$_{t-1}$	-0.017***	-0.021***	-0.014***	-0.010***	-0.009***	-0.006*	-0.024***	-0.020***	-0.018***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Transport obstacle$_{t-1}$	0.108***	0.155***	0.056	0.018	-0.011	0.054	-0.014	-0.011	0.001
	(0.033)	(0.047)	(0.047)	(0.031)	(0.043)	(0.044)	(0.031)	(0.044)	(0.045)
Number of power outages (log)$_{t-1}$	0.134***	-0.115**	0.258***	-1.094***	-2.232***	-0.994***	-0.972***	-2.030***	-0.885***
	(0.031)	(0.051)	(0.038)	(0.104)	(0.194)	(0.138)	(0.105)	(0.196)	(0.140)
Female Ownership	-0.460***	-0.446***	-0.450***	-0.181***	-0.125	-0.187***	-0.174***	-0.132	-0.180***
	(0.051)	(0.088)	(0.063)	(0.049)	(0.082)	(0.062)	(0.049)	(0.083)	(0.061)
Location (= large city)	-0.374***	-0.635***	-0.220***	0.123***	0.022	0.184***	0.165***	0.066	0.214***
	(0.031)	(0.048)	(0.041)	(0.034)	(0.051)	(0.046)	(0.034)	(0.052)	(0.046)
Large size firm	0.956***	0.966***	0.886***	1.271***	1.314***	1.268***	1.247***	1.280***	1.243***
	(0.052)	(0.069)	(0.082)	(0.051)	(0.067)	(0.082)	(0.052)	(0.068)	(0.083)
Firm sales$_{t-3}$	0.630***	0.622***	0.624***	0.499***	0.473***	0.510***	0.505***	0.483***	0.514***
	(0.005)	(0.008)	(0.006)	(0.006)	(0.009)	(0.007)	(0.006)	(0.009)	(0.008)
GDP per capita$_{t-1}$	0.000	-0.000	0.000**	-0.001***	-0.001***	-0.001***	-0.000**	-0.001***	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Domestic investment$_{t-1}$	0.021***	0.021***	0.018***	0.054***	0.072***	0.028***	0.050***	0.059***	0.028**
	(0.002)	(0.003)	(0.003)	(0.007)	(0.012)	(0.010)	(0.008)	(0.013)	(0.012)
Observation	33626	14827	18799	33000	14827	18173	31804	14422	17382
F-stats	3307.523	2068.271	1400.387	1291.059	665.072	693.594	1197.051	611.067	615.337
R^2	0.604	0.661	0.556	0.692	0.743	0.647	0.465	0.494	0.443
Kleibergen-Paap rk Wald F statistic							1462	2579	672
Kleibergen-Paap rk LM statistic							4197	2946	1544
Chi-sq(2) P-value							0.000	0.000	0.000
Industry fixed effect				Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect				Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect				Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4.18: Effect of international remittances per capita on the number of permanent and full-time employees

	Dependent variable : Number of full-time employees(log)								
	Ordinary least squares model			Fixed-effects model			Instrumental variable approach with fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture	All	Manufacture	Non-Manufacture
Remittances per capita$_{t-1}$	0.000***	0.000	0.000***	0.000	-0.002*	0.001	0.007***	0.004***	0.010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Trade (% of GDP)$_{t-1}$	-0.001***	-0.001	-0.000*	-0.000	0.003	-0.001	0.002	0.002	0.004*
	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Unemployment rate$_{t-1}$	-0.000	0.006***	0.001	-0.016**	0.021	-0.016	-0.059***	-0.012	-0.082***
	(0.001)	(0.002)	(0.001)	(0.008)	(0.015)	(0.011)	(0.010)	(0.016)	(0.015)
Time to start business$_{t-1}$	-0.000	0.000	-0.001***	-0.002***	-0.003***	-0.001	-0.003***	-0.003***	-0.001*
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Real exchange rate$_{t-1}$	-0.434***	-0.700***	-0.404***	0.263	-0.440	0.457	1.210***	-0.077	2.137***
	(0.068)	(0.108)	(0.088)	(0.322)	(0.529)	(0.425)	(0.384)	(0.587)	(0.540)
Domestic credit to private$_{t-1}$	0.002***	0.001**	0.002***	0.006*	0.003	0.007	0.017***	0.014*	0.019***
	(0.000)	(0.000)	(0.000)	(0.003)	(0.006)	(0.004)	(0.004)	(0.007)	(0.005)
Political stability index$_{t-1}$	-0.037***	-0.083***	-0.016**	0.044	0.136**	0.109***	-0.024	0.027	0.068
	(0.007)	(0.011)	(0.008)	(0.030)	(0.060)	(0.040)	(0.039)	(0.072)	(0.052)
Corruption index$_{t-1}$	-0.000	-0.001	0.001*	0.003***	0.002*	0.003***	-0.001	-0.000	-0.001
	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Transport obstacle$_{t-1}$	0.010	0.011	-0.006	0.010	0.004	0.012	0.003	0.004	0.001
	(0.010)	(0.016)	(0.014)	(0.010)	(0.015)	(0.014)	(0.011)	(0.016)	(0.014)
Number of power outages (log)$_{t-1}$	-0.073***	-0.119***	-0.044***	0.066*	0.120*	0.099**	0.114***	0.159**	0.169***
	(0.010)	(0.017)	(0.012)	(0.034)	(0.072)	(0.045)	(0.035)	(0.074)	(0.047)
Female Ownership	-0.220***	-0.208***	-0.202***	-0.225***	-0.209***	-0.237***	-0.226***	-0.217***	-0.236***
	(0.016)	(0.027)	(0.019)	(0.016)	(0.027)	(0.019)	(0.016)	(0.027)	(0.020)
Location (= large city)	0.145***	0.151***	0.152***	0.134***	0.174***	0.111***	0.134***	0.178***	0.111***
	(0.010)	(0.015)	(0.012)	(0.011)	(0.017)	(0.015)	(0.011)	(0.018)	(0.015)
Large size firm	2.630***	2.557***	2.625***	2.457***	2.416***	2.484***	2.455***	2.417***	2.473***
	(0.015)	(0.019)	(0.023)	(0.015)	(0.020)	(0.024)	(0.016)	(0.020)	(0.025)
GDP per capita$_{t-1}$	0.000***	0.000***	0.000***	0.000	0.000	0.000	0.000***	0.000*	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Domestic investment$_{t-1}$	0.004***	0.004***	0.004***	0.003	0.004	0.006**	-0.003	-0.002	-0.005
	(0.001)	(0.001)	(0.001)	(0.002)	(0.004)	(0.003)	(0.003)	(0.005)	(0.004)
Observation	33206	14683	18523	32593	14683	17910	31404	14279	17125
F-stats	2402.462	1366.332	961.341	1827.833	1029.396	773.112	1751.925	1002.710	729.457
R^2	0.556	0.600	0.496	0.588	0.636	0.507	0.509	0.562	0.441
Kleibergen-Paap rk Wald F statistic							1407	2572	630
Kleibergen-Paap rk LM statistic							4051	2869	1503
Chi-sq(2) P-value							0.000	0.000	0.000
Industry fixed effect				Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect				Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect				Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses are clustered at the country level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Chapter 5

Structural Change And Trade Openness

This chapter is published in «World Economy» and was co-authored with Justin Lin and Mary-Françoise Renard

Abstract

In this paper, we study the role of trade openness in the economic reallocation from the agriculture to the manufacturing sector in 34 Sub-Saharan African countries between 1970-2016. The results show that the long term evolution of trade openness negatively impacts the long-run and the short-run dynamics of structural change. Moreover, this impact goes through aggregate exports not aggregate imports. By breaking down global exports, we find that commodities exports have a negative impact while manufacturing exports positively impact structural change. These results are explained by the fact that, contrary to Asian countries, African countries have failed to put trade at the service of industrialization by following the logic of comparative advantage. More precisely, they have failed to invest the revenues from commodities exports to improve the quality of infrastructure in order to remove the constraints on the relocation to labor-intensive manufacturing activities. Unlike previous studies, we address the endogeneity problem by using a dynamic ordinary least squares method after a pooled mean group method.

5.1 Introduction

Most research on economic development began with questions on structural change (SC) from agriculture to industry (Atolia et al. 2020; Murphy et al. 1989*b*; Kuznets & Murphy, 1966; Lewis, 1954). Indeed, SC means reallocation of economic activity from the low productivity sector (agriculture) to the high productivity sector (industry).[1] Thus, it is an industrialization process that leads to total factor productivity growth even if productivity has not increased within sectors (McMillan & Rodrik, 2011). For example, if workers move from agriculture to industry, total factor productivity will increase because the labor force moved from the low productivity sector to the high productivity sector (Lewis, 1954). So, the magnitude of the SC's effect on economic development will depend on its direction and the speed at which economic reallocation to industry occurs. In addition, economic development is a conditional process of continuous industrial and technological upgrading (Lin, 2012).

The main determinants of the nature of SC are the industrial and trade policies implemented by the states. These policies can lead to a SC involving either industrialization or deindustrialization depending on how they are implemented. During the nineteenth century, the countries of Asia, Africa, and Latin America underwent a process of deindustrialization. Their total share in world manufacturing output fell from 60.5% in 1830 to 7.5% in 1913 (Nayyar, 2019). This period being the colonial era, it was marked by a massive global investment in their natural resource sectors and a concentration of the global manufacturing investment in the United States and Europe, which were the colonizers. Although this deindustrialization was a common phenomenon to all the previously mentioned three regions during colonization, the period of 1970-2016 was marked by some divergences among them in terms of industrialization. Between 1970-2016, the share of manufacturing value-added in GDP increased from 10% to 23% in Asia while that of East Asia in global manufacturing value-added increased from 4% to 41% (Nayyar, 2019). In Sub-Saharan Africa (SSA), the manufacturing value-added share in

[1] In this paper, the term industry or industrialization refers only to manufacturing according to literature about industrialization (Rodrik, 2016*b*; Gui-Diby & Renard, 2015; Kang & Lee, 2011)

GDP fell from about 13% in 1980 to 10% in 2016, its share in the global manufacturing production fell from 3% in 1970 to less than 2% in 2010 (Page et al. 2016). As a result, SC has been growth-enhancing in Asia while it has been growth-reducing in SSA (McMillan et al. 2014). However, the deindustrialization in SSA is puzzling because this region has the lowest average wage in the world so it should benefit more from economic reallocation of labor-intensive manufacturing compared to other regions.

Another difference between Asian and SSA countries lies in the industrial and trade policies as a support for industrialization. During the 1950s and 1960s, some Asian countries, like many developing countries in other parts of the world, opted for trade protection policies because of the deindustrialization of the colonial period. On the one hand, these trade strategies took the form of import substitution policies aimed at protecting the local manufacturing sector development. On the other hand, it took the form of state intervention in order to guide the firms in the labor-intensive primary manufacturing industries following their comparative advantage (Lin, 2009). Although a large majority of these countries opened up to international trade during the 1980's, their particularity lies in the progressive modification of the content of their exports. In some cases, they began to export agricultural raw materials, and then a significant share of these exports was gradually made up of labor-intensive manufacturing goods and later of capital-intensive manufacturing products. After their independence, some SSA leaders had the ambition to industrialize their country to no longer depend on their former colonial power. Thus, their idea was to create the same capital-intensive industries as in developed countries. These policies were initially accompanied by an industrial dynamism in some SSA countries. In 1960, the shares of the manufacturing value-added in GDP were 9%, 10%, 14%, 16% and 20% respectively in Kenya, Senegal, Congo, Zimbabwe and South Africa (Austin et al. 2016). For many SSA countries, the end of the 1980s was marked by a trade openness that allowed them to export sizeable natural resources with a low rate of diversification. As a result, the annual growth rate of the manufacturing sector, which was 8% between 1961-1970 in SSA, was reduced to 5.1%, 1.9% and 1.1% respectively between 1971-1980, 1981-1990, and 1991-2000.

At one point in their history, Asia and SSA have implemented first trade protection and then trade openness policies. However, the trade measures taken by the governments of these two regions have been different as the nature of their SC. Thus, the purpose of this paper is to understand how trade openness and industrial policy explain the nature or the direction of SC in 34 SSA countries between 1970-2016. Our interest in this period is determined by the fact that it includes both a large part of trade protection (1970- the end of 1980s) and trade liberalization periods (after the end of 1980s) in Africa. Due to data constraints, we do not consider the periods before 1970 and after 2016.

Given the importance of SC in the process of economic growth and development, it is the subject of many research papers. The first half of this literature studies the nature of SC and its implications in terms of growth and poverty reduction in Africa (McMillan & Rodrik, 2011; De Brauw et al. 2014; Christiaensen & Todo, 2014). The second half is based on the constraints related to the SC (Bräutigam & Tang, 2014; Collier & Dercon, 2014; Harrison et al. 2014).[2] According to McMillan & Headey (2014), the research on this issue remains poor in terms of empirical analysis in the case of Africa which implies that our knowledge about this question in SSA is very limited. Indeed, some of these papers are based on descriptive statistics, which are correlation and not causality analyses (De Brauw et al. 2014; Dorosh & Thurlow, 2014; McMillan & Headey, 2014; Collier & Dercon, 2014; Bräutigam & Tang, 2014). In addition, the papers that perform econometric analyses use ordinary least squares as an estimation method (Christiaensen & Todo, 2014; Harrison et al. 2014; McMillan & Rodrik, 2011), which does not consider endogeneity bias. Also, these papers study a limited number of African countries due to a lack of data related to manufacturing employment for most of SSA countries.

In order to fill the methodological gap, we perform pooled mean group (PMG) and dynamic ordinary least squares (DOLS) to model a long-run relationship between SC and trade openness. The relevance of the empirical methods lies in the fact that SC is a long-run process during which there is a reallocation of economic

[2] McMillan & Headey (2014) provide an overview about structural change literature in Africa.

activity from agriculture to industry. In addition, they also make it possible to take into account endogeneity bias (DOLS) and the fallacious regression.[3] Concerning the measurement gap, we measure SC by the ratio between the manufacturing value-added and agriculture value-added; the availability of these data allows to study an important number of countries in SSA. In addition, we contribute to the literature through a theoretical and historical discussion on trade and industrial policies in Asia and SSA. This allows us to examine how differences in industrial and trade policies have led to different patterns of structural transformation between these two regions.

The empirical results show that trade openness is a barrier to SC and thus to industrialization in SSA. Indeed, the long-term evolution of trade openness negatively affects the long-run and short-run dynamics of SC and this negative impact goes through aggregate exports, but not aggregate imports. By breaking down global exports, we find that commodities exports have a negative impact while manufacturing exports have a positive impact on SC. This surprising result can be explained mainly by bad decisions in industrial and trade policies. First, the post-independence industrial policies focused on the creation of capital-intensive industries while the comparative advantage of African countries is in labor-intensive industries. Second, the trade policies of the end of the 1980s were based on a deep specialization in the exports of raw materials without investing exports' resources in the development of a competitive domestic industrial sector. Indeed, SSA countries suffer from significant infrastructure constraints, which represent a significant transaction cost for the industrial activities. Consequently, the return on investment in manufacturing activities will be low and may be lower than that in imports activities. Still, as a result of infrastructure constraints and the poor business environment, the risk associated with the creation of a new industry will be high relative to the risk associated with import activities. In this context, even with a comparative advantage in low-skilled labor-intensive industries, the entrepreneurs in SSA will prefer to import rather than invest in manufactur-

[3]The endogeneity bias in this case manifests by the fact that there could be an inverse causality between SC and trade openness. In addition, we study a macroeconomic model in which the variables can be explained by each other.

ing sector. Therefore, a trade openness based on commodities exports without a resources-investment policy will crowd out the manufacturing sector. This effect will be amplified by the rise of GDP per capita due to commodities exports, which will increase the domestic demand, but with a weak industrial base, the rise of the domestic demand will lead to an increase in the demand for foreign products.

The rest of this paper is organized as follows: we present in Section 5.2 the history, debate and the measures of SC; the literature review will be presented in Section 5.3; stylized facts, variables and data description are presented in Section 5.4; empirical strategy will be discussed in the Section 5.5; the results will be presented in Section 5.6; and Section 5.7 will be the concluding remarks.

5.2 Structural change and trade policies: history, debate, and measures

This section is summarized in three main parts. First, it describes the industrial and trade policies undertaken in some Asia and SSA countries and their consequences on the nature of SC. Second, it presents the debate between services and industrialization as key driver of total factor productivity growth. Third, we will discuss the measures of SC.

5.2.1 Structural change and trade policies: Asia versus sub-Saharan Africa

Although industrialization was an important objective of the independence period in Asia and SSA, the policies to achieve this goal led to two different results in terms of SC. The aim of this sub-section is to present how trade measures and state intervention have explained the nature of SC in the two regions.

Structural change and trade policies in Asia

The SC performance in Asia has been accepted as the result of its trade and industrial policies. State intervention had built the bases of industrialization in this region (Wade, 2004). Indeed, the industrial policies in the post-colonial period can be understood in the context of colonization. According to Nayyar (2019), the colonial era has been marked by trade openness which was accompanied by deindustrialization. Hence, after their independence, the purpose of the industrial policies was to protect the local manufacturing sector. Although some individual particularities can be noted, the industrial strategies were threefold. First, the manufacturing firms in the labor intensive sector have benefited from the import substitution policies. In some economies like Korea and Taiwan, the aim of trade policies was to protect the export manufacturing sector by an undervaluation of the exchange rate and restrict trade for other sectors. Second, there have been strategies for guiding and coordinating firms. This has taken shape in public investments in hard and soft infrastructure and an incentive for banks to provide long-term credit for investments that are oriented towards the industrial sector.[4] For example, in Korea, banks have been encouraged to charge differentiated interest rates depending whether investments are oriented towards the sector of comparative advantage or not; while in Taiwan, there were credit taxes. Given the scarcity of resources, these policies aimed at allocating them to well identified sectors. Third, in some economies like China, South Korea, Taiwan, and Vietnam, some agrarian and land redistribution reforms have been implemented. As a result of these reforms, the exports of agricultural products increased in these countries. (Wade, 2004). According to Rodrik (1995), the plausible explanation of the Asian miracle can be understood through the previous measures mentioned above. Indeed, given the high return on physical capital in Taiwan and Korea, the interventionist policies of their governments were to coordinate the investment decisions of the economic agents. Thus, the trade openness of the 1960s was the result of a strong import-demand for inputs in order to support the investment demand.

Trade openness in most Asian countries was marked by an increasing share of the world trade and an upgrade of their exports content (Lin, 2012; Nayyar, 2019). The eight best performing economies in East Asia recorded a growth in their share of world exports, from 7.9% in 1965 to 13.1% in 1980, and 18.2% in 1990 (Page,

[4]Hard infrastructure: energy, transport, telecommunication. Soft infrastructure: finance

1994). The contribution of manufacturing exports was the main reason for this trade performance. Between 1965-1990, Japan became the leading exporter of manufacturing products in the world, its share increasing from 8% to 12%, between 1970-1980 (Page, 1994). In the same time, the world share of manufactured exports from the four tigers has grown almost four times faster than that of Japan.[5] According to Lin (2012), in the 1990s, China was a major exporter of raw materials but in the 2000s, it moved from this type of export to sophisticated goods exports. India also is following this path. In Malaysia, the Philippines and Thailand, the share of primary commodities in total exports was 80% in 1980 and then about 20%-30% in 2016; their shares of medium and high-technology industrial products have been 50%, 75% and 50% in 2016 (Nayyar, 2019). In Indonesia, the share of primary commodities in total exports was 80% in 1980 and then about 30% in 2016 while it decreased from 60% to 20% in Sri Lanka. Concerning resource-based and low-technology industrial products, their share in total exports for the same years increased from 18% and 50% in Indonesia and from 35% to 70% in Sri Lanka.

Structural change and trade policies in sub-Saharan Africa

After their independence, the leaders of SSA countries were convinced that the economic development of African nations should go through industrialization. «Industry...is the means by which rapid improvement in Africa's living standards is possible...» Kwame Nkrumah (1965).[6]

To achieve this goal, they have put in place two strategies of industrialization. On the one hand, the state was the initiator of industrialization, which motivated it to create and invest heavily in state-owned industries. On the other hand, to ensure a balance between domestic demand and production, trade protection policies have been implemented through very high customs tariffs. These import substitution policies were implemented both by the " socialist " states like Ghana under Kwame Nkrumah; Guinea under Sekou Touré; Tanzania under Julius Nyerere etc, and the " capitalist " states like Côte d'Ivoire under Houphouët-Boigny and Kenya

[5] The four tigers: South Korea, Hong Kong, Singapour and Taïwan
[6] Kwame Nkrumah is the first president of Ghana and the hero of this country's independence.

under Jomo Kenyatta (Austin et al. 2016). Unlike Asian countries, the objective of these policies was that the local industrial production should serve domestic consumption instead of export. In line with these measures, there has been industrial development in some SSA countries. In fact, industrial sector has grown by 14.6% per year in SSA between 1965-1973, and this was more than double the GDP growth which was 6.6% per year over the same period (Newman et al. 2016). From 1965 to 1970, manufacturing production increased by more than 7% in 7 SSA countries (Newman et al. 2016).[7] This manufacturing growth was about 8% in Ethiopia and Ghana, 10% in Tanzania and Uganda. Although the interventionist strategy led to growth in the manufacturing sector, the success of trade protection policies and massive investment in state-owned enterprises quickly became short-lived. These industrialization programs were based on the production of capital-intensive goods, while SSA is characterized by a scarcity of capital and an abundance of less skilled labor. For example, in the 1970s, one of the industrial ambition of the Democratic Republic of Congo was the construction of an automobile factory while its main competitor was the United States with a large gap in terms of income per capita and capital availability (Lin, 2012). Over the same period, the capital intensity doubled in Senegal as industrial production declined (Meier et al. 1989). After their independence, the government of Ghana invested in the electronic and machinery industries in order to produce domestically the production inputs. Although import substitution policies have been implemented by most SSA countries, there have been some differences in their application. Indeed, a large majority of the French colonies remained in the colonial monetary zone at the time called " franc des Colonies Fançaises d'Afrique ", while most British colonies together with Guinea opted for monetary independence. In the case of the second group of countries, exchange rate overvaluation policies were put in place. Theoretically, exchange rate overvaluation would act as an indirect subsidy to manufacturing firms, allowing them to import intermediate inputs and capital goods below world prices. This strategy reduced the incentive to invest in the agricultural export activities, which in turn led to a shortage of foreign exchange reserves

[7]The 7 SSA countries: Ethiopia, Ghana, Kenya, Nigeria, Senegal, Tanzania and Uganda.

for imports of intermediate inputs. Moreover, the industrial development strategy was based on a massive public investment in state-owned enterprises, rather than on the improvement of their productivity. This resulted in public expenditures far greater than the tax-raising capacity of governments. As a result of these measures, the high level of customs duties contributed to reducing the efficiency of domestic finished goods production. In fact, the cost of importing intermediate inputs exceeded the import price of finished manufactured goods (Newman et al. 2016). The ineffectiveness of public spending and trade measures forced SSA governments to consolidate their public finances. Thus, the 1980s marked the end of public intervention in favor of economic liberalization advocated by the international institutions.

In the context of debt unsustainability, the international institutions including the World Bank (WB) and the International Monetary fund (IMF) advocated for some reforms. Known as " structural adjustment programs ", these reforms were followed by deindustrialization in SSA. Over the mid-1990s, the manufacturing growth rate was lower than that of 1985-1990 in eight SSA countries (Newman et al. 2016).[8] From 1980 to 1985, manufacturing growth became negative in Ghana, Nigeria, and Tanzania, it remained at 4% in Ethiopia, Kenya, Senegal and Uganda. The average growth rate of manufacturing in Ghana fell from 7.5% at the end of the 1980s to -7.4% at the beginning of the 1990s. Furthermore, the manufacturing value-added per worker decreased for many SSA countries between 1995-2010: from 100 to 64; 56; 36; 66, respectively in Ethiopia, Kenya, Mozambique, and Senegal (Page et al. 2016). Although in the case of other developing countries the manufacturing share in the global exports was from 10% in 1980 to 29.6% in 2011, it was from 3% to 2.8% in Africa (Newman et al. 2016). One characteristic of this period was that most SSA countries exported sizeable natural resources with a high level of concentration.[9]

Clearly, at some point of their history, Asia and SSA have implemented industrialization policies, based sometimes on trade protection and sometimes on trade

[8] The 8 countries: Ethiopia, Ghana, Kenya, Mozambique, Nigeria, Senegal, Tanzania, and Uganda.

[9] See Appendix A for the concentration index.

liberalization while the nature of their SC has been different. The explanation of the results of these policies can be understood through the role of states in the implementation of industrial strategy. The post-independence industrial policies have failed to generate sustainable growth in SSA because they were not based on countries' comparative advantages. In most SSA countries, the state has been unable to guide and coordinate the local entrepreneurs towards the comparative advantage sector. Indeed, countries with a relative natural resources abundance or unskilled labor force and scarcity of human and physical capital must create labor-intensive and natural resource-intensive industries. The liberalisation policies have also failed because most African governments didn't use the commodity exports' revenues to reduce the constraints related to soft and hard infrastructure deficits that lead to high transaction costs, inhibiting the development of manufacturing domestically.

5.2.2 Debate on structural change in sub-Saharan Africa

According to Gui-Diby & Renard (2015), at least 26 African countries had an industrialization strategy in 2017. In July 2016, the United Nations General Assembly adopted a resolution announcing the third decade of the industrial development in Africa. Although it is an important issue for African policy-makers, some observers argue that SSA can experience a growth miracle with SC between agriculture and services (McMillan & Harttgen, 2014). In fact, a reallocation of economic activity from agriculture to manufacturing can be a real driver of poverty reduction and employment (Rodrik, 2016*a*). However, SC between agriculture and services is less likely to impact the total factor productivity in SSA. Indeed, the type of services - for example information technology - that impacts the overall productivity requires a very skilled labor force. As an illustration, it takes several years of study and institutional quality improvement to transform a farmer into a programmer or into a call center operator. However, it only takes manual dexterity and physical capital to transform a farmer into a worker in a labor-intensive manufacturing industry multiplying his productivity by two or three (Rodrik, 2016*a*). It is the case of China, people moving from agriculture to industry and from industry to services.

However, it should be noted that these services represent inputs for the primary sector in some developing countries. The introduction of mobile phones in the city of Kerala in India would have allowed fishermen to make price arbitration between different markets increasing their profit by 8% (Jensen, 2007). The Kenyan mobile banking system (M-Pesa) has reportedly allowed some very poor women to leave the agricultural to the non-agricultural activities (Suri & Jack, 2016). Thus, these examples show that high-tech services could facilitate structural transformation from agriculture to industry but they are not a driver of overall productivity growth and unemployment reduction (Rodrik, 2018).

The manufacturing sector in Africa has both advantages and disadvantages. One undeniable advantage is its competitiveness in terms of labor costs. As labor costs are increasing in Asian countries, SSA could be the future area of relocation of labor-intensive production and/or assembly activities (Lin, 2012). In this context, SSA could benefit from the global value chains (GVCs) by integrating it more fully into global markets. The other advantage of the African manufacturing industry is the high young population growth on this continent. According to the African Development Bank (AfDB) Group's report - Strategy of the Bank Group for Youth Employment in Africa 2016-2025 -, the young African population will double in 2050 reaching 830 million. This demographic growth is a boon to industrialization both in terms of labor availability and in terms of demand for African manufacturing goods.

Despite the previous advantages, this sector is still undermined by several problems related to the business environment. In SSA, most companies recognized business environment constraints such as power outages and regulatory burden as a major problem. For example, the losses associated with power outages can reach 10% of firms' sales in some countries (Gelb et al. 2014). About 1/3 of the enterprises report poor conditions of transport networks as a major constraint. On average, 40% of firms in SSA report that bribery practices are common.

5.2.3 Measures of structural change

According to Rodrik (2016*b*), Gui-Diby & Renard (2015), Kang & Lee (2011), industrialization is measured by the manufacturing value-added share in GDP or by the manufacturing employment share in total employment. From the new structural economics perspective, it is equally important to measure the employment and the value-added share of manufacturing sectors with different capital intensities (Lin, 2011*b*). SC is defined as a reallocation of economic activity between agriculture, manufacturing and services (Herrendorf et al. 2014). Starting from this definition, the authors stipulate that SC from the production perspective is measured either by the evolution of the sectoral value-added shares in GDP or by the evolution of the sectoral employment shares in total employment. According to them, the main limitation of using employment as a SC proxy is that the change in employment may not reflect the real changes in labor as input. Indeed, employment is determined either by the number of workers or by the number of hours worked. However, there may be differences between the number of hours worked and human capital between sectors due to countries' level of development (Herrendorf et al. 2014). In addition, data for manufacturing employment exist for few SSA countries. Hence, SC between agriculture and manufacturing is measured in this paper by the ratio of their value-added. This measure typically corresponds to a reallocation of economic activity between these two sectors. The ratio between manufacturing and agriculture reflects the way in which the value-added of manufacturing increases (decreases) over time compared to that of agriculture. Thus, the variations in such a ratio how manufacturing gains (losses) contribute to GDP relative to agriculture, reflecting a reallocation of economic activity between the two sectors.

$$SC_{i,t} = \frac{MANUFACTURING\_VALUE\_ADDED_{i,t}}{AGRICULTURE\_VALUE\_ADDED_{i,t}} \tag{5.1}$$

With: i and t representing respectively the country and year index.

This ratio tells us when a SC is in the right or in the wrong direction. A decrease in $SC_{i,t}$ over time shows a structural change based on deindustrialization and an increase in this indicator over time is considered as a SC involving industrialization. If the value of SC is lower than 1, the share of agriculture in GDP is higher than that of manufacturing (poor performance of SC). Conversely, if its value is higher than 1, we will say that the share of manufacturing in GDP is higher than that of agriculture (good performance of SC).

5.3 Literature review

Many papers have studied the determinants and the impacts of SC but few of them focus on the case of Africa. The literature that has studied SC in Africa can be organized into two main categories. The first focuses on the characteristics and the nature of economic reallocation and the second studies the constraints related to the SC.

5.3.1 The nature of structural change in Africa

According to the Lewis dual economy model, developing countries are characterized by a traditional sector with low productivity level and a modern sector with high level of productivity. Thus, SC that leads to economic development is defined by a reallocation of economic activity from the traditional to the modern sector. Nevertheless, the evolution has been different in Africa (McMillan & Headey, 2014; McMillan & Rodrik, 2011). Based on disaggregated data on sectoral employments, McMillan & Rodrik (2011) show that SC has been growth-reducing from 1990 to 1999 in the case of Latin America and Africa. According to the authors, one of the factors that helps to understand this result is the natural resources endowment. Indeed, in countries with a high share of natural resources in total exports, SC is a source of reduced economic growth and productivity. One of the main reasons is that the natural resources sector - mineral - is a highly productive sector that cannot absorb a significant amount of unskilled labor. Another explanation about the reduction of growth by SC could be the type of urban migration that SSA countries have experienced (Rodrik, 2016*b*; De Brauw et al. 2014). In the case of many developing countries, rural areas are composed of low-productive agricultural activities while urban areas are characterized by the existence of non-agricultural activities particularly industrial production. Thus, labor migration from rural to urban areas should take the form of a SC involving industrialization. However, De Brauw et al. (2014) show that a significant proportion of African population resides in rural places. Although cities abound in activities that can provide better returns than agricultural sector, the migration rate towards them is still very low in several African countries. Specifically, the annual migration rate in these countries was estimated at 1% from 1990 to 2000 (De Brauw et al. 2014). In many SSA countries, the experience of labor migration from rural to urban areas has resulted in a concentration of labor in traditional services instead of industrial sector (Rodrik, 2016*b*). Moreover, in some countries, there has been a movement of labor from the manufacturing sector to the traditional sector, particularly agriculture (McMillan & Headey, 2014). In this section, one conclusion can be summarized: in the case of most SSA countries, SC was in the wrong direction and its impact on economic growth and the living standard depends on its nature.

5.3.2 The constraints related to structural change in Africa

Although manufacturing industries are more productive than agriculture, SSA has not experienced a real reallocation of economic activity from the traditional to the modern sector to allow a significant improvement in the standard of living. For example, a large part of the labor force is concentrated in the agricultural sector in Africa. More precisely, the share of agricultural employment reaches 80% of the active population in some African countries (McMillan & Headey, 2014). If manufacturing is more productive than agriculture, why does Africa not experience an economic reallocation towards manufacturing? Using samples including African and non-African cross-country firm level data, Harrison et al. (2014) show that manufacturing industries in Africa perform less than those elsewhere. According to the authors, manufacturing firms in Africa have a low level of productivity; they sell, export, and invest less than others. However, when they control for infrastructure and the quality of institutions, it appears that African firms perform better than others. The business environment - especially the quality of infrastructure and institutions - needs to be improved so as to increase the competitiveness and labor absorption capacity of the manufacturing sector in Africa. In this context, Bräutigam & Tang (2014) have done a qualitative analysis of how foreign direct investment - especially Chinese investments - may result in SC in Africa. According to the authors, foreign investments in Africa can lead to a SC if they are attracted in special economic zones (SEZs). In addition, Harrison et al. (2014) find that the impact of foreign ownership is higher in Africa than in other developing economies. The papers by Harrison et al. (2014) and Bräutigam & Tang (2014) highlight the constraints related to manufacturing industry in Africa to explain why a real SC does not occur. In this sense, Collier & Dercon (2014) study the constraints related to the African agricultural sector. They show that a real SC can occur if productivity increases in agriculture; this would lead to a movement of labor from agriculture to manufacturing. So, the policymakers in Africa should make the agricultural sector more marketable. Finally, Dorosh & Thurlow (2014) highlighted the role of state in the process of SC in Ethiopia and Uganda. They wonder in which sector state must invest more to force a real structural transformation. Developing dynamic economy-wide models, they conclude that public investment in cities is an important determinant of SC in the long term, because the modern sectors are located in cities. However, in the short term, for an imperative of poverty reduction, they suggest further public investment in agriculture.

5.4 Stylized facts, variables and data description

We focus here on respectively the stylized facts and the description of variables and data.

5.4.1 Stylized facts

This sub-section presents different stylized facts about SC and trade in our sample. Between 1970-2016, SSA experienced on average two periods of SC between agriculture and manufacturing (see the first graph of Figure 5.1). First, a slight increase appears in the share of manufacturing value-added in GDP and and a decrease appears in agriculture's share from 1970 to the end of 1980s (the first graph of Figure 5.1). This can be interpreted as a structural transformation leading to industrialization even if the increase of manufacturing and the decrease of agriculture are very weak. However, at the end of the 1980s, we can see a slight SC involving deindustrialization because manufacturing decreased and agriculture increased. Although it remains a simple correlation, these two types of SC correspond to two different periods of trade policy. On the one hand, the period of SC involving industrialization corresponds to that of protectionist policies in SSA. On the other hand, the period of SC leading to deindustrialization corresponds on average to the period of trade liberalization of the SSA countries. Also, it appears that the share of agriculture in GDP is still on average higher than that of manufacturing which in the case of SSA reflects a poor performance of SC. Although it is the key sector of economic development, the share of manufacturing in GDP was still very low in SSA from 1970 to 2016 (about 10% in 2016).

The first graph of Figure 5.1 does not provide information about the productivity difference between agriculture and manufacturing. To address this, we collect data for 11 SSA countries on the sectoral shares in GDP and total employment from the Groningen Growth and Development Centre database. This database is relevant because it provides sectoral employment for 11 SSA countries in addition to the sectoral value-added.[10] Hence, the second graph of Figure 5.1 shows the average shares of manufacturing and agriculture in GDP and total employment between 1970-2000 and 2000-2011.[11] It appears that from 1970 to 2000, the share of agriculture in total employment was higher than its share in GDP and it was the opposite for the manufacturing sector. Arithmetically, this reflects the higher productivity in manufacturing sector. The important fact that emerges from Figure 5.1 is that manufacturing is more productive than agriculture in SSA but its share in total employment is still very small. Consequently, a reallocation of economic

[10]The 11 SSA countries for which data on manufacturing employment exist are: Botswana, Ethiopia, Ghana, Kenya, Malawi, Mauritius, Nigeria, Senegal, South Africa, Tanzania, and Zambia.

[11]We look at the period before and after 2000 because McMillan & Rodrik (2011) show that the contribution of SC to economic growth is different in the two periods. Also, 2011 is the end of period because of data lack.

activity from agriculture to manufacturing should be an important source of economic growth in Africa. Indeed, a significant number of workers would leave the low productivity (agriculture) to the high productivity sector (manufacturing). This will lead to an increase in overall productivity in SSA even if productivity within sectors does not increase. A more precise analysis clearly shows the low technological level of African industries (Table 5.2). From 2000 to 2015, 87% of employment was in low level technology manufactures and only 1.47% in high technology manufactures.[12]

Over the period of the beginning of trade openness policy (1995-2000), the exports from SSA remained highly concentrated in a small number of products compared to the other regions in the world (with a concentration index of about 0.25).[13] Over the period 2001-2018, the exports were still more concentrated with 0.37 as the average concentration index (see the first two graphs of Figure 5.2).[14] With an average concentration index of just over 0.06 and 0.08 between 1995-2000 and 2001-2018, respectively the imports in SSA are less concentrated than those in Asia and North America (see the second two graphs of Figure 5.2).

5.4.2 Variables and data description

Table 5.1 presents the variables of our econometric models. The ratio between the manufacturing and agriculture value-added is the SC measure. The "de facto" trade openness index is the variable of interest while aggregate exports and imports are its transmission channels. In order to study the transmission channels of aggregate exports, they are broken down into commodities and manufacturing exports. Our variables of control are: exchange rate overvaluation, market size,

[12]Data come from the United Nations Industrial Development Organization (UNIDO) database. The average number of people employed in each sector is calculated on the countries in our sample for which we have data. The period 2000-2015 is chosen because of data availability. Finally, South Africa is excluded because of its industrial weight compared to other SSA countries.

[13]The concentration index provides information on whether exports are concentrated on a small number of products or are homogeneously distributed over several products. This index ranges from 0 (exports are homogeneously distributed among products) to 1 (exports are highly concentrated in a small number of products). No data are available on export and import concentration index before 1995.

[14]The export concentration index is represented over the period 2001-2018 in order to understand how the degree of export concentration has changed in the time.

public investment, private investment, the quality of institutions and the financial globalization.

Table 5.1: Data and Variables description

Variables	Description	Source
Structural change	Structural change indicator represents our dependant variable, it is determined from the ratio between the value-added of manufacturing and agricultural sector. To allow comparison between countries and to control the effect of inflation, these two variables are in constant 2010 dollar prices (https://unstats.un.org/unsd/snaama/Basic).	United Nations Statistics Division (UNSD) database.
Trade openness	Trade openness represents our variable of interest, it is measured by the "de facto" KOF trade globalisation index. This index is calculated as the weighted average between trade in goods, trade in services, and the diversity of trading partners. Trade in goods represents the weighted share of exports and imports of goods in GDP. Trade in services represents the weighted share of exports and imports of services in GDP. Finally, the diversity of trading partners is measured by the inverse of the Herfindahl-Hirschman's market concentration index for exports and imports of goods - which is also weighted - . The relevance of this index as measure of trade openness lies in the fact that unlike the usual measures of trade openness, it makes it possible to take into account the diversity of trading partners which is an additional information. (https://www.kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html). About the contributions relating to the KOF trade globalization index see Gygli et al. (2019) and Dreher (2006). In order to explain the transmission channels of trade openness, exports and imports are introduced. In order to explain the transmission channels of exports they are disaggregated into primary commodities in the SITC 0 + 1 + 2 + 3 + 4 + 68 + 667+ 971 classification and manufactured goods in the SITC 5 to 8 less 667 and 68 classification.	KOF Swiss Economic Institute database (for trade openness indicator); United Nations Statistics Division (UNSD) database (for aggregate exports and aggregate imports) and United Nations Conference on Trade and Developement (for primary commodities and manufactured goods exports).
Real exchange rate overvaluation	This variable allows to understand how the under- or overvaluation of the real exchange rate affects SC. We refer to authors who show that an undervaluation of exchange rate impacts positively while overvaluation affects negatively manufacturing competitiveness in developing countries (Rodrik, 2008; McMillan et al. 2014). To measure the real exchange rate overvaluation index, we use Rodrik (2008) method, which is summarized in three steps. For more information about the calculation method of this index, see Rodrik (2008).	Penn World table 9.1.
Market size	According to Murphy et al. (1989*a*), in developing countries, market size is an important determinant of a SC that leads to industrialization. Indeed, exports, particularly those of mineral and/or agricultural natural resources increase national income. Thus, if income is distributed and concentrated in the hands of the middle class, then manufacturing products demand will increase, as the latter is the class that consumes the most industrial products. Empirically, a number of studies on industrialization (Rodrik, 2016*b*; Gui-Diby & Renard, 2015; Kang & Lee, 2011; Kaya, 2010; Rowthorn & Ramaswamy, 1999) measure market size or income level by GDP per capita. GDP per capita is calculated as the ratio between GDP in constant 2010 dollar terms and population size (https://unstats.un.org/unsd/snaama/Basic).	United Nations Statistics Division (UNSD) database.
Public investment	Public investment share in GDP (in percentage terms) is use to take into account public intervention. According to Newman et al. (2016), an important dimension of post-independence industrial policies was massive public investment in state-owned industries in some African countries. In addition, according to Dorosh & Thurlow (2014), public investment in cities is a source of SC in some African countries. Noted «Public investment», this variable is in international dollar constant 2005 prices (https://www.imf.org/external/np/fad/publicinvestment/data/data.xlsx).	International Monetary Fund database.
Private investment	According to Murphy et al. (1989*b*), firms' transition from traditional to industrial sector must take the form of simultaneous private investment in order to increase market size. Empirical studies such as Kang & Lee (2011), Kaya (2010), Rowthorn & Ramaswamy (1999) find that investment has a positive impact on industrialization. However, in the context of dutch disease, economic resources are directed towards the natural resources sector to the detriment of the manufacturing sector. As proof, Gui-Diby & Renard (2015) find that investment impacts negatively industrializalition in Africa. Then the effect of private investment is taken into account by using the share of private investment in GDP (in international dollars constant 2005 prices) and is noted «Private investment» (https://www.imf.org/external/np/fad/publicinvestment/data/data.xlsx).	International Monetary Fund database.
Institutions	Some studies about natural resources curse explain that natural resources boom has a deleterious effect on industrialization only in countries with poor quality of institutions (Mehlum et al. 2006). Thus, the impact of exports could be explained by the quality of institutions. Hence, the effect of institutional quality is controlled. The quality of institutions is determined as the difference between the democracy and autocracy variable. It ranges from +10 (highly democratic country) to -10 (highly autocratic country).	The POLITY2 index in POLITY4 database.
Services value added	According to Gui-Diby & Renard (2015), in the context of structural change, the evolution of one variable can affect the dynamics of other sectors. In this sense, the effect of the share of services' value added in GDP (Services) is controlled (https://unstats.un.org/unsd/snaama/Basic).	United Nations Statistics Division (UNSD) database.
Financial flow	According to Gui-Diby & Renard (2015), FDI at best have no effect on industrialization, and at worst, have a negative effect in the case of Africa. Moreover, Kose et al. (2009) show that external debt flows have a negative impact on total factor productivity. Thus, to control the effect of international capital flows, we use the «de facto» KOF index of financial globalisation (https://www.kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html). It is calculated as the weighted average between foreign direct investment, portfolio investment, international debt, international reserves, and international income payment. The expected sign of this variable can be both positive and negative depending on whether or not foreign capital is directed towards the manufacturing sector.	KOF Swiss Economic Institute database.

5.5 Empirical strategy

We use pooled mean group (PMG) and dynamic ordinary least squares (DOLS) estimation methods in our analysis. These techniques allow for modeling the long-run and the short-run relationships between SC and trade openness. However, we are only interested in the long-term effects of the explanatory variables, although these effects are studied on both the short-run and long-run evolution of the dependent variable. The PMG and the DOLS also make it possible to consider the endogeneity issue and the fallacious regression. The endogeneity bias in this case is manifested by the fact that there could be a causal relationship between the explanatory variables and the error term. Thus, the PMG method is used first as estimation method and then the DOLS method is applied in robustness. However, before performing these two methods, it is necessary to verify the stationarity of the individual variables and the cointegration of their combinations. Thus, some unit root and cointegration tests are carried out prior to the PMG and the DOLS.

5.5.1 Units root and co-integration tests

According to Mignon & Hurlin (2005), there are mainly two generations of panel unit root tests. The first one (Levin & Lin, 1993; Hadri et al. 1999; Harris & Tzavalis, 1999; Maddala & Wu, 1999; Choi; 2001; Levin et al. 2002; Im et al. 2003) is based on an absence of inter-individual correlation in any form (Mignon & Hurlin, 2005). The second generation (Bai & Ng, 2001; Phillips & Sul, 2003; Moon & Perron, 2004; Choi, 2002; Pesaran, 2007) attempts to control all interdependencies that could exist between the individuals.

In this paper, we apply three unit root tests from the aforementioned generations. We first perform two tests from the first generation (Im et al., 2003 and Choi, 2001) and then one test from the second generation (Pesaran, 2007). The choice of Im et al. (2003) and Choi (2001) is explained by the following reasons. Indeed, unlike Levin & Lin (1993) and Harris & Tzavalis (1999), Im et al. (2003) and Choi (2001) consider the unit roots as heterogeneous across individuals, which is relevant in a macroeconomic study such as this one (see Hurlin & Mignon, 2005).

Moreover, Im et al. (2003), postulate a heterogeneity of the existence of unit roots across individuals. These assumptions are realistic and plausible in our study because some heterogeneous characteristics between countries can generate different unit roots and can imply the occurrence of the unit root in some countries and not in other countries. The test from Choi (2001) applies a fisher-type test on each panel separately (meta-analysis) while considering the combination of the p-values from the individual tests as an overall test. Such an approach is consistent with the time series approach, which is different from the rest of the first generation tests. The test of Pesaran (2007) is performed because its approach remains substantially close to the DOLS which is the robustness estimation method in this paper.[15] Indeed, unlike some second-generation tests that transform the series to be tested, Pesaran (2007) keeps the raw variable to be tested. The authors introduce into the Augmented-Dicker-Fuller model (ADF) the individual means of the variable that is delayed by period and the first differences of the latter in instantaneous (Mignon & Hurlin, 2005). For the sake of consistency, we will consider a variable as stationary if all the three tests simultaneously reject the null hypothesis of non stationarity.

Similar to the unit root tests, two generations of cointegration tests exist. The first one concerns the assumption of homogeneous cointegration relationships between individuals. It postulates that the cointegration relationship cannot exist between some individuals in the panel without existing between other individuals in the same panel. (Kao, 1999; Pedroni, 1999). The second generation of tests stipulates the existence of heterogeneous cointegration relations (Westerlund, 2005). More precisely, it considers that a cointegration can exist between one group of individuals without being the case for other individuals in the same panel. Thus, to consider a combination of variables as cointegrated, all the three tests must simultaneously reject the null hypothesis of no cointegration.

[15]The similarity between the Pesaran (2007) method and the DOLS relies on the fact that the latter also stores the raw data of the variables while it adds the first difference advanced and delayed (Mignon & Hurlin, 2007).

5.5.2 Estimation method

The PMG method is an econometric technique applied to cointegrated panels. According to Blackburne III & Frank (2007), the main characteristic of cointegrated variables is their reactivity to any deviation from the long-run equilibrium. This feature allows using an error-correction model for cointegrated panels that links the long-run and short-run dynamics. In this type of model, the short-run dynamics will be influenced by any deviation from the long-term equilibrium (Blackburne III & Frank, 2007). Thus, the PMG allows estimating an error-correction model by the maximum likelihood method:

$$\Delta y_{i,t} = \phi_i(y_{i,t-1} - \theta_i X_{i,t}) + \sum_{j=1}^{p-1} \lambda_{i,j} \Delta y_{i,t-1} + \sum_{j=0}^{q-1} \sigma_{i,j} \Delta X_{i,t-j} + \mu_i + \epsilon_{i,t} \tag{5.2}$$

where i=1,2,...N represents the group number and t represents the time period. The first term $(y_{i,t-1} - \theta_i' X_{i,t})$ in equation 5.2 represents the long-term dynamics while the first difference variables reflect the short-term dynamics. ϕ_i is the error correction term that reflects the speed at which there is a return to the long-term equilibrium. Then, the long-term relationship exists if ϕ_i is different from zero; there is a return to the long-term equilibrium if ϕ_i is negative and significant. Thus, it is not necessary to test the cointegration of the model if ϕ_i is negative and significant (Blackburne III & Frank, 2007). Hence, the condition for using an error correction model is that the error correcting coefficient becomes negative and significant. $\Delta y_{i,t}$ represents the dependent variable (SC). The first difference of SC is the dependent variable in the PMG models because the error correction coefficients show that we cannot apply the PMG on the models in which the SC, as a dependent variable, is in level form. However, this is relevant as it allows for studying the long run dynamics' effects of the variables on the SC's short run dynamics in the PMG while the effects on the long term dynamics of SC will be studied in the DOLS models.

$X_{i,t}$ represents the vector of explanatory variables. It should be noted that only the first-order integrated explanatory variables are included in both the long-run and short-run dynamics. The variables that will eventually be stationary in level form will be in the short term dynamics, therefore they will be only in first difference. To understand the transmission channels of trade openness' effect on SC, we will replace it by the variables named «Exports and Imports». Then, in order to explain the sign of Exports, we replace it by the variables named «Commodities exports and Manufacturing exports». θ_i is the vector of the long-term coefficients and $\sigma_{i,j}$ is the vector of the short-term coefficients. $\lambda_{i,j}$ is a scalar corresponding to the coefficients of the delay of the first difference of the dependent variable. μ_i corresponds to the country fixed effects and $\epsilon_{i,t}$ is the identically and independently distributed error term.

Before estimations, the Hausman test is applied. It allows for a comparison between the estimator of the mean group (MG) and that of the PMG in order to choose the best model. The difference between these two methods comes from the fact that the long term dynamics is supposed to be homogeneous in all groups of the panel for PMG while it is heterogeneous in MG (Blackburne III & Frank, 2007). The null hypothesis of this test corresponds to the efficiency of the PMG estimator compared to the MG estimator.

Although the PMG introduces the lagged values of the variables in first difference, this is insufficient to fully address the endogeneity problem between the explanatory variables and the error term. To overcome this, another cointegrated panel estimation method which takes this issue well into account is performed for robustness.

5.5.3 Robustness check

In this study, we test the robustness of the PMG results by performing the DOLS method in order to correct for endogeneity. DOLS is a cointegrated panel estimation technique that consists of introducing into a cointegrating relationship the advanced and delayed values of the first difference of the explanatory variables. The introduction of the two previous terms consists of controlling the possible endogeneity of the explanatory variables by eliminating a correlation between them and the error term. Kao & Chiang (2001) studied the finite-sample properties of estimators from homogeneous cointegrated panel estimation methods. Their investigation concerned the Ordinary Least Squares (OLS) method, Fully Modified Ordinary Least Squares and DOLS. They concluded that DOLS substantially improved the estimators from the other two methods.

$$y_{i,t} = \alpha_i + \beta X_{i,t} + \sum_{k=_-\infty}^{\infty} \delta_{i,k} \Delta X_{i,t+k} + \epsilon^*_{i,t} \tag{5.3}$$

Where $X_{i,t}$ represents a vector grouping all of explanatory variables. The first-order integrated explanatory variables will be in level form and in first difference while the variables stationary in level form will be in the short-term dynamics, so in first difference.

$y_{i,t}$ corresponds to the structural change measure noted SC. β represents the vector of the long run coefficients along the explanatory variables. The introduction of the term $\sum\limits_{k=_-\infty}^{\infty} \delta_{i,k} \Delta X_{i,t+k}$ in equation 5.3 allows for controlling the correlation between the explanatory variables and the error term. The DOLS estimators are obtained by estimating the equation using the OLS.

5.6 Results

This section presents all the results obtained from the empirical strategy. The results of the unit root and cointegration tests are presented initially, followed by those of the PMG and the DOLS.

5.6.1 Results of the unit root and the cointegration tests

Tables 5.3, 5.4 and 5.5 report the results of the unit root tests from Im et al. (2003), Choi (2001) and Pesaran (2007), respectively. The null hypothesis of non stationarity (in level form) is simultaneously rejected by the three tests in the case of four variables (Overvalue, Private investment, Public investment and Institutions). Thus, these variables are considered as stationary and they will only be introduced in the short run part of the PMG and the DOLS. Therefore, the variables: Structural change, Trade openness, Market size, Services, Financial flow, Exports, Imports, Commodities exports and Manufacturing exports are considered as first-order integrated variables. It should be noted that the threshold of significance considered in the present tests is 1%. More precisely, we reject the null hypothesis of non stationarity only if the p-value is less than or equal to 1%.

Table 5.6 presents the results of the three cointegration tests related to the combinations of variables estimated by the DOLS. The combinations of variables considered are all cointegrated because the null hypothesis of non cointegration is rejected in all cases.[16]

5.6.2 Results of pooled mean group estimations

Table 5.7 presents the results of the PMG estimation. The variables that are stationary in first difference are simultaneously in the long-run dynamics and in the short-run dynamics (Trade openness, Market size, Services, Financial flow, Exports and Imports). The variables that are stationary in level form are only in the short-run dynamics (Private investment, Public investment, Institutions, Overvalue). In all combinations of variables, the error correction coefficients (Speed adjustment) are negative and significant (column 1-4). Therefore, the long term relationships exist and there is a return of variables to the long-run equilibrium.[17] From the column 1 to 4, the result of the Hausman test is reported. Note that the Hausman test could not be applied on the complete models including all the explanatory variables. This is because the number of iterations of MG exceeded what our data allowed due to the high number of explanatory variables. To perform the Hausman test, we applied the estimates of the PMG and MG on two different models. The first is the model without the value added of services and the second without the variable of financial flows. The choice to gradually remove these two variables - in order to perform the Hausman test - is explained by the following reason. They are the only control variables that are in both the long-run and short-run dynamics, thus, by gradually removing them, the number of explanatory variables is reduced so that the MG and therefore the Hausman test can be applied. From column 1

[16] The Stata command (xtcointtest) that allows to run the three cointegration tests does not support more than seven explanatory variables.

[17] Note that we are only interested in the effect of the long-run dynamics of the variables of interest.

to 4, in the two models, the p-value of the Hausman test does not reject the null hypothesis which states that the PMG estimator is more efficient compared to the MG one. Based on the previous conclusion, we apply the PMG on the complete model with all explanatory variables.

The first column reports the combination of variables in which trade openness is the variable of interest. In column 1, the indicator of trade openness (in level form) negatively and significantly impacts the first difference of SC. Thus, the long-term evolution of trade openness negatively impacts the short-run dynamics of SC.

To understand the transmission channels of trade openness' effect, we replace it by the share of exports and imports in GDP. Hence, the columns 2, 3 and 4 present these effects when the share of exports and that of imports in GDP replaces the trade openness index. Column 2 considers the combination of variables in which the share of exports in GDP is the variable of interest while column 3 reports the combination in which the share of imports in GDP is the variable of interest. Finally, the column 4 presents the set of variables with the share of exports and that of imports in GDP as variables of interest. The long run dynamics of exports negatively and significantly affects the short run dynamics of SC - columns 2 & 4 - while the long term dynamics of imports positively and significantly impacts SC (in first difference; column 4). The coefficient of the trade openness (-.0021107) is considerably lower than those of exports (-.1527709 & -.1518654) and imports (.057296). This could be explained by the fact that the trade openness indicator encompasses many things including diversity of trading partners and trade in services in addition to trade in goods. Moreover, the effects of exports are larger and more significant than those of imports. Therefore, exports could be the single variable through which the negative impact of trade openness passes.

From the previous findings, it appears that trade openness negatively affects the short run dynamics of SC and that this negative effect is driven by exports. As the PMG method allows for studying the long run dynamic effects of trade on the short run dynamics of SC, it is important to understand the long term dynamics of trade on the long term dynamics of SC. In this sense, the DOLS are applied, which also allows for good control of the endogeneity issue compared to the PMG method.

5.6.3 Robustness check

The present subsection considers the combinations of variables estimated by the DOLS method, these results are reported in Table 5.8. As in PMG, the variables that are stationary in first difference are simultaneously in the long term dynamics and in the short term dynamics while those stationary in level form are only in the short run dynamics. Hence, the dependent variable is in level form allowing to study the long run dynamics' effects of the variables of interest on the long term dynamics of SC. However, the short term effects of the variables in level form are automatically considered in the DOLS estimations, so their coefficients will not appear in Table 5.8.

In the DOLS estimations, we consider the default lag (2) and the default lead (1) as well as the default level (95). Column 1 is the combination of variables in which the trade openness indicator corresponds to the variable of interest. From this column, it appears that the long-term evolution of trade openness negatively and significantly affects the long-run dynamics of SC.

The transmission channels are studied in columns 2, 3 and 4. The share of exports in GDP (in level form) negatively and significantly impacts the long term evolution of SC (columns 2 & 4) while the share of imports in GDP has no significant effect. As explained previously, the coefficients of exports are higher than that of trade openness.

In addition, the long term coefficients of trade openness and exports in the DOLS estimations are higher than their long run coefficients in the PMG models. This may be explained by the fact that the two methods have two different measures of the dependent variable. In PMG, the first difference of SC is the dependent variable while it is considered in level in DOLS. Hence, this shows that the long run dynamics of trade openness and exports influences more the long term dynamics of SC than its short run dynamics.

From the PMG and the DOLS estimations, the share of exports in GDP is the channel through which the trade openness affects SC. Therefore, the exports are disaggregated into commodities exports and manufacturing exports. Table 5.9 presents the results of DOLS estimations when the exports of commodities and manufacturing products are considered as variables of interest while controlling the effects of imports. From column 2 to column 9, the commodities exports (in level form) negatively and significantly affect the long run dynamics of SC while manufacturing exports positively impacts it. However, the effect of commodities exports (column 9) is more significant than that of manufacturing exports. This could be explained by the weak industrial base of African countries. In addition, it could explain why the overall effects of exports - the effects of total exports in GDP - are negative. Moreover, the coefficients of manufacturing exports are higher that those of commodities exports showing that the magnitude of manufacturing exports is more important. In the first column, the effect of commodities exports is positive but it becomes negative when the effect of market size is controlled, this may be explained through the spending effect discussed in the next subsection.

From the previous results, it appears that the negative effect of the long-run dynamics of trade openness passes through commodities exports.

5.6.4 Theoretical discussion

Our results show that the long-run effect of trade openness on the long-term and the short-run dynamics of SC is negative and passes through commodities exports. Therefore, trade openness is a barrier to SC and then to industrialization in SSA. This surprising result can be mainly explained by two mistakes in the industrial and trade policies. First, the post-independence industrial policies focused on the creation of capital-intensive industries while the comparative advantage of African countries is in labor-intensive industries. Second, the trade policies of the end of the 1980s were based on a deep specialization in the exports of raw materials without investing exports' resources in the development of a competitive domestic industrial sector. Indeed, SSA countries suffer from significant infrastructure constraints, which represent significant transaction costs for the industrial activities. Consequently, the return on investment in manufacturing activities will be low and may be lower than that in imports activities. Still, as a result of infrastructure constraints and the poor business environment, the risk associated with the creation of a new industry will be high relative to the risk associated with import activities. In this context, even with a comparative advantage in low-skilled labor-intensive industries, the entrepreneurs in SSA will prefer to import rather than invest in manufacturing sector. Therefore, a trade openness based on commodities exports without a resources-investment policy will crowd out the manufacturing sector. This effect will be amplified by the rise of GDP per capita due to commodities exports, which will increase the domestic demand, but with a weak industrial base, the rise of the domestic demand will lead to an increase in the demand for foreign products.

5.7 Concluding remarks

Economic openness has been considered by the main international institutions and many economists as the best way for African countries to develop. Nevertheless, the situation in most of these countries does not confirm this idea. Economic development may be approximated by structural change which illustrates a country's ability to move from agriculture to industry. Considering the importance of this subject and the consequences in terms of political economy, we studied how trade openness has impacted the structural change. We find in this paper that trade openness negatively affects structural change in 34 SSA countries between 1970-2016, and this negative impact goes through exports and not imports. This is explained by the fact that states in Africa have failed to put trade policy at the service of industrialization by following the logic of comparative advantage. More precisely, they have failed to invest the exports revenues to improve hard and soft infrastructure in order to remove the constraints on relocation to labor-intensive manufacturing activity.

Therefore, industrial and trade policies are the roots of this mechanism. As argued in the New Structural Economics (Lin, 2011*b*), the factor-endowment based comparative advantages only determines the factor costs of production for an industry. The competitiveness of an industry in domestic and international markets also depends on transaction costs, which are determined by infrastructure and business environment, in addition to the factor costs of production for the industry. If African governments can help to reduce the transaction costs with good infrastructure and business environment for the labor-intensive industries, African countries will be able to produce and export labor-intensive manufacturing goods as East Asian countries have done.

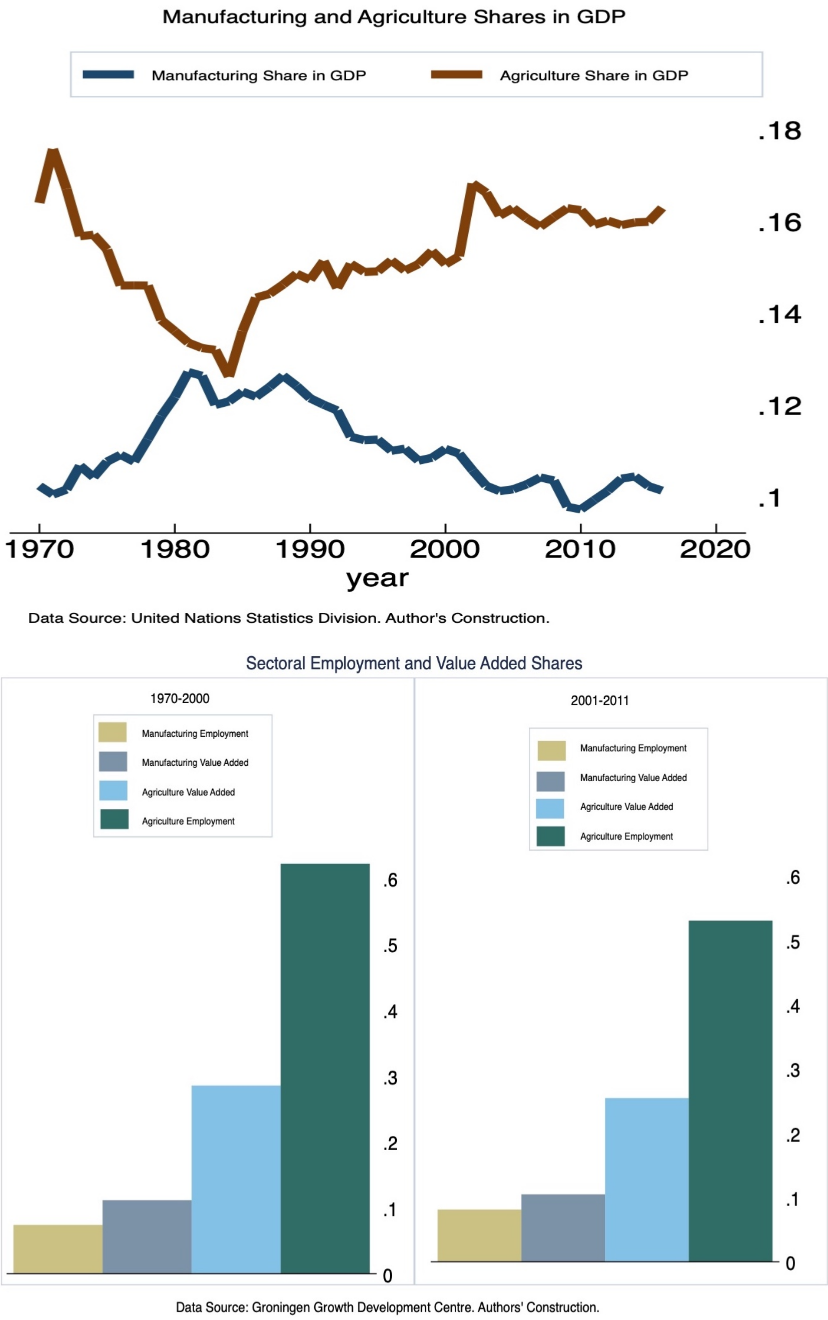


Figure 5.1: Structural change and productivity difference between agriculture and manufacturing

Table 5.2: The Structure of Manufacturing Employment 2000-2015

Manufacturing	Employment(%)	Manufacturing	Female Employment(%)
Sector of activity	103,52*	Sector of activity	29.94
Paper and paper products	2.00	Wood products (excl. furniture)	5.78
Tobacco products	3.49	Fabricated metal products	11.29
Leather. leather products and footwear	3.64	Rubber and plastics products	13.95
Fabricated metal products	5.11	Paper and paper products	20.95
Furniture; manufacturing n.e.c.	6.16	Food and beverages	22.60
Wood products (excl. furniture)	6.86	Furniture; manufacturing n.e.c.	23.41
Rubber and plastics products	8.05	Leather. leather products and footwear	31.05
Wearing apparel. fur	10.54	Tobacco products	38.92
Textiles	10.68	Textiles	48.05
Food and beverages	30.85	Wearing apparel. fur	89.11
Low technology manufactures	87.38	Low technology manufactures	
Other transport equipment	.20	Other transport equipment	7.02
Machinery and equipment n.e.c.	1.16	Machinery and equipment n.e.c.	11.43
Motor vehicles. trailers. semi-trailers	1.52	Motor vehicles. trailers. semi-trailers	13.38
Chemicals and chemical products	5.71	Chemicals and chemical products	23.69
Medium technology manufactures	8.59	Medium technology manufactures	
Medical. precision and optical instruments	.10	Coke.refined petroleum products.nuclear fuel	6.50
Office. accounting and computing machinery	.12	Medical. precision and optical instruments	10.92
Radio.television and communication equipment	.12	Electrical machinery and apparatus	18.79
Coke.refined petroleum products.nuclear fuel	.39	Office. accounting and computing machinery	33.64
Electrical machinery and apparatus	.74	Radio.television and communication equipment	76.22
High technology manufactures	1.47	High technology manufactures	
Recycling	.04	Basic metals	4.50
Basic metals	2.77	Recycling	20.63
Printing and publishing	3.27	Printing and publishing	32.74
Unclassified products	6.08	Unclassified products	

Data source: United Nations Industrial Development Organization.

*The fact that the total employment share of sectoral activity is greater than 100% (103.52%) could be due to some data processing errors.

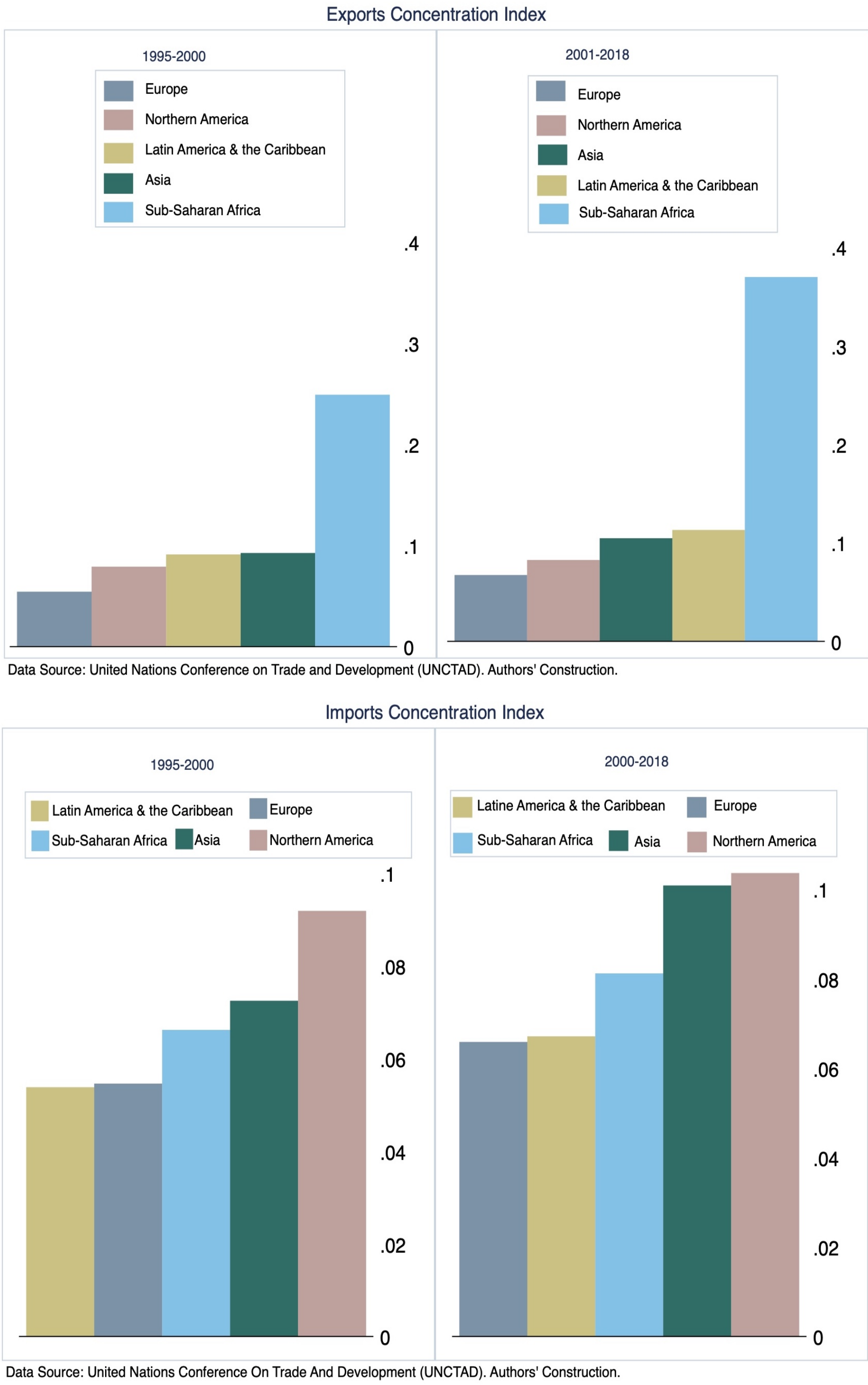


Figure 5.2: Trade concentration in the world regions

Table 5.3: Unit root tests of Im, Pesaran, and Shin (2003)

	Level		Difference	
	W-t-bar	P-value	W-t-bar	P-value
Structural change	-2.6254	0.0043	-23.6074	0.0000
Trade openness	-2.9560	0.0016	-34.6986	0.0000
Market size	0.9099	0.8186	-25.5303	0.0000
Overvalue	-3.2581	0.0006	-28.8503	0.0000
Private investment	-6.0642	0.0000	-32.6232	0.0000
Public investment	-5.0098	0.0000	-36.0397	0.0000
Financial flow	-0.2749	0.3917	-33.2385	0.0000
Institutions	-3.9899	0.0000	-30.2068	0.0000
Exports	-1.3713	0.0851	-37.5976	0.0000
Imports	-1.7427	0.0407	-31.7554	0.0000
Commodities exports	3.6320	0.9999	-18.1607	0.0000
Manufacturing exports	1.4972	0.9328	-20.1674	0.0000
Services	-1.4104	0.0792	-34.1483	0.0000

Cross-sectional means removed; Trend: included; ADF regressions: lags average (chosen by AIC)

Table 5.4: Unit root tests of Choi (2001)

	Level		Difference	
	Inverse chi-squared(68)	P-value	Inverse chi-squared(68)	P-value
Structural change	89.6186	0.0407	459.7901	0.0000
Trade openness	83.3658	0.0992	720.5550	0.0000
Market size	59.3147	0.7646	420.8672	0.0000
Overvalue	119.8320	0.0001	656.7123	0.0000
Private investment	172.0334	0.0000	768.7588	0.0000
Public investment	120.9433	0.0001	687.9636	0.0000
Financial flow	63.0972	0.6456	626.8327	0.0000
Institutions	125.4033	0.0000	622.5646	0.0000
Exports	55.4213	0.8633	594.8207	0.0000
Imports	93.7159	0.0211	684.0933	0.0000
Commodities exports	27.7861	1.0000	204.5625	0.0000
Manufacturing exports	52.2547	0.9211	272.6022	0.0000
Services	74.8380	0.2661	651.9471	0.0000

Cross-sectional means removed; Trend: included; ADF regressions: lags average (1)

Table 5.5: Unit root test of Pesaran (2005)

	Level		Difference	
	Z[t-bar]	P-value	Z[t-bar]	P-value
Structural change	-0.120	0.452	-16.820	0.000
Trade openness	-0.698	0.242	-16.924	0.000
Market size	-3.294	0.000	-15.310	0.000
Overvalue	-3.753	0.000	-17.835	0.000
Private investment	-5.889	0.000	-18.776	0.000
Public investment	-2.356	0.009	-17.386	0.000
Financial flow	-1.366	0.086	-17.598	0.000
Institutions	-4.534	0.000	-18.936	0.000
Exports	-0.976	0.165	-16.934	0.000
Imports	-1.914	0.028	-17.236	0.000
Commodities exports	-0.213	0.416	-6.822	0.000
Manufacturing exports	-0.829	0.203	-8.304	0.000
Services	-1.234	0.109	-17.197	0.000

Deterministics chosen: constant and trend. Augmented by 1 lags (average)

Table 5.6: Cointegration tests

	Statistic	P-value
Cointegration tests of Table 7 (Kao. 1999)		
Column 1	-8.1157	0.0000
Column 2	-8.2790	0.0000
Column 3	-8.1389	0.0000
Cointegration tests of Table 8 (Kao. 1999)		
Column 6	5.4411	0.0000
Cointegration tests of Table 7 (Pedroni, P. 1999)		
Column 1	3.5542	0.0002
Column 2	3.8541	0.0001
Column 3	2.6736	0.0038
Cointegration tests of Table 8 (Pedroni, P. 1999)		
Column 6	5.9021	0.0000
Cointegration tests of Table 7 (Westerlund, J. 2005)		
Column 1	4.2619	0.0000
Column 2	3.9368	0.0000
Column 3	5.1482	0.0000
Cointegration tests of Table 8 (Westerlund, J. 2005)		
Column 6	10.0863	0.0000
AR parameter: Panel specific. For all cointegration tests		
Panel means: Included. Lags(aic). For Kao. 1999		
Panel means: Included.Time trend: Included. For Pedroni, P. 1999		
Panel means: Included.Time trend: Included. For Westerlund, J. 2005		

Table 5.7: Results of pooled mean group regression (Trade, Exports and Imports=variables of interest). Dependent variable=Structural Change (SC) in first difference

Variables	(1) D.SC	(2) D.SC	(3) D.SC	(4) D.SC
Long term				
Trade openness	-.0021107***			
	(.0004399)			
Market size	.0001805***	.0001462***	.0002058***	.0001472***
	(.0000181)	(.0000145)	(.0000201)	(.0000147)
Services	.0844419***	.0475774	.1138835**	.0800284**
	(.0295534)	(.037624)	(.0538892)	(.0383079)
Financial flow	-.0005264	-.0009145***	-.0021849***	-.0011364***
	(.0004532)	(.0003329)	(.0004745)	(.0003395)
Exports		-.1527709***		-.1518654***
		(.0502625)		(.0520921)
Imports			.0532131	.057296*
			(.0484063)	(.0337941)
Short term				
D.Trade openness	.0009553			
	(.0007692)			
D.Market Size	-.0000439	-.0000289	-.0000521	-.0000292
	(.0001249)	(.0001065)	(.0000988)	(.0000961)
D.Private investment	.0058382	.0065547	.0041486	.005646
	(.0056816)	(.0055025)	(.0063938)	(.0071945)
D.Public investment	.0538132	.052118	.0535493	.0520154
	(.0537545)	(.0531388)	(.0533028)	(.0529558)
D.Institutions	.0183557	.0186742	.0163783	.0150417
	(.0149779)	(.0171489)	(.0150384)	(.0167394)
D.Overvalue	.4233416	.3820578	.5339482	.438734
	(.6543199)	(.6740034)	(.5998952)	(.6139992)
D.Services	1.342541	1.529346	1.382024	1.588423
	(1.016762)	(1.179363)	(1.146947)	(1.310509)
D.Financial flow	.0012726	.000986	.0022509*	.0014937*
	(.0011705)	(.0008384)	(.0013581)	(.0009013)
D.Exports		.4697152		.480681*
		(.298485)		(.2713108)
D.Imports			.4010649	.3225534
			(.2662685)	(.2508033)
Speed adjustment	-.1642026***	-.1793462***	-.1630352***	-.184284***
	(.0350534)	(.0354316)	(.0314962)	(.03593)
Log likelihood	2477.415	2500.092	2491.72	2532.98
Hausman test p-value: Model with financial flow	0.88	0.37	0.61	0.79
Hausman test p-value: Model with services	0.61	0.96	0.86	0.27
Observations	1440	1441	1441	1441
Number of country	34	34	34	34

Notes: robust standard errors are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5.8: Results of dynamic ordinary least squares (Trade, Exports and Imports=variables of interest). Dependent variable=Structural Change (SC)

	(1)	(2)	(3)	(4)
Variables	SC	SC	SC	SC
Long term				
Trade openness	-.0076458**			
	(.0032351)			
Market size	.0006705***	.0006917***	.0006687***	.0006995***
	(.0000275)	(.0000275)	(.0000274)	(.0000272)
Services	1.974076***	1.56599***	1.871118***	1.440138
	(.4477717)	(.4603088)	(.4448313)	(.4569518)
Financial flow	.0001524	.0003297	-.006175**	-.0003084
	(.0034178)	(.0032161)	(.0031567)	(.0031748)
Exports		-.8502828**		-.9987805***
		(.3342852)		(.3491011)
Imports			.2654616	.416993
			(.2630464)	(.2771208)
Short term				
D.Private investment	-.0077444	-.0099882*	-.0076349	-.010517
	(.0057618)	(.0057713)	(.0057411)	(.005726)
D.Public investment	-.0032855	-.0055682	-.0068059	-.0059569
	(.0077747)	(.0077907)	(.0077212)	.0076903
D.Institutions	-.0143746	-.0181957	-.0087786	-.0161653
	(.0114702)	(.0115031)	.0113962	(.0113553)
D.Overvalue	-.481386	-.3757975	-.5972287	-.4780664
	(.4713986)	(.4722814)	(.4683098)	(.4664018)
R2	0.5578	0.5689	0.5617	0.5847
Wald chi2	665.58***	696.89***	686.62***	738.12***
Number of lags	2	2	2	2
Number of leads	1	1	1	1
Observations	1131	1131	1131	1131
Number of country	29	29	29	29

Notes: robust standard errors are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5.9: Results of dynamic ordinary least squares (Trade, Exports and Imports=variables of interest). Dependent variable=Structural Change (SC)

Variables	(1) SC	(2) SC	(3) SC	(4) SC	(5) SC	(6) SC	(7) SC	(8) SC	(9) SC
Long term									
Commodities exports	7.461784***	-2.500147***	-2.356291**	-2.330151**	-2.350349**	-2.342119**	-2.886397***	-2.673329***	-3.104344**
	(1.300944)	(.7617856)	(.9779092)	(.977993)	(.9787037)	(.9850031)	(.9675338)	(.9611609)	(.9951719)
Manufacturing exports	8.92155*	5.646871**	5.698859**	5.737565**	5.71137**	5.581255**	6.169063**	6.790427**	4.967643*
	(4.874452)	(2.272052)	(2.691295)	(2.702651)	(2.7028)	(2.73495)	(2.686608)	(2.666392)	(2.680079)
Market size		.0007507***	.0007586***	.0007589***	.000759***	.000768	.0007868***	.0007846***	.000799
		(.0000472)	(.0000617)	(.0000617)	(.0000617)	(.0000622)	(.0000614)	(.0000618)	(.0000622)
Services							-1.103008	-1.061427	-1.352422
							(1.224092)	(1.213779)	(1.221038)
Financial flow								-.0047392	-.0078099
								(.0079871)	(.0080082)
Imports									1.163895*
									(.6892334)
Short term									
D.Private investment			-.0229423*	-.0186855	-.020132	-.019114	-.0103941	-.0072953	-.0240858*
			(.0131471)	(.0133312)	(.013382)	(.0134687)	(.0133931)	(.0132792)	(.0133311)
D.Public investment				-.0103331	-.0104343	-.009962	-.011885	-.0162152	-.0114526
				(.0187076)	(.0187109)	(.0188322)	(.0184968)	(.0183593)	(.0183615)
D.Institutions					-.0620709*	-.055355*	-.0548493*	-.055315*	-.0547462*
					(.0321339)	(.0323455)	(.0318085)	(.0315354)	(.0315467)
D.Overvalue						.7724858	.7832072	.5960143	.0008766
						(1.007958)	(.9899629)	(.9882157)	(.9887854)
R2	0.21458	0.6368	0.6103	0.6111	0.6140	0.6203	0.6103	0.6221	0.6279
Wald chi2	43.83***	339.12***	199.83***	198.97***	202.74	204.02	211.71	222.75	226.45***
Number of lags	2	2	2	2	2	2	2	2	2
Number of leads	1	1	1	1	1	1	1	1	1
Observations	612	612	510	510	510	510	510	510	510
Number of country	34	34	34	34	34	34	34	34	34

Notes: robust standard errors are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5.10: List of Country

Country	Country
Benin	Guinea-Bissau
Botswana	Kenya
Burkina Faso	Lesotho
Burundi	Malawi
Cabo Verde	Mali
Cameroon	Mauritania
Central African Republic	Mozambique
Chad	Niger
Congo. Rep.	Nigeria
Cote d'Ivoire	Rwanda
Equatorial Guinea	Senegal
Eswatini	Sierra Leone
Ethiopia	South Africa
Gabon	Tanzania
Gambia. The	Togo
Ghana	Zambia
Guinea	Zimbabwe

Chapter 6

The China Syndrome and Deindustrialization

This chapter is co-authored with Mary-Françoise Renard and has been selected to be part of a book that will be published soon

Abstract Since the beginning of the 21st century, China's influence has been growing around the world. The stakes are particularly high for emerging and developing countries. This paper analysis the effect of China trade on the manufacturing sector both in 53 African countries and in 98 developing countries excluding Africa (78 emerging economies and 20 low income economies) between 1995-2021. Our results show that trade with China is a source of deindustrialization in Africa on both aggregate exports and imports side. However, although imports of other developing countries from China are also a source of deindustrialization, exports to China are a source of industrialization for these countries. Thus, in terms of exports to China, our results show that Africa is a special case compared to other developing countries. More precisely, we find that the impact of aggregate exports is through heavy dependence on commodities exports to China.

6.1 Introduction

Since the beginning of the 21st century, China's influence is spreading around the world with now a particular interest for countries associated with the Belt and Road Initiative and more broadly with developing countries. From a theoretical point of view, it is consistent with the defense of the superiority of South-South trade over North-South trade for the development of these countries.

The underlying arguments related to this type of international trade were mainly threefold (Greenaway & Milner, 1990; Lin, 2011*a*):

- First, a problem of exports diversification: since the comparative advantage of developed regions lies in industrial production, there will be a failure to diversify exports from developing countries because of their natural resource endowment. This reason is confirmed by Kaba et al. (2022) who show that the high concentration of exports from African countries explains the negative impact of trade openness on industrialization.
- Second, a capture of gains from trade: developed economies would capture a large part of trade gains due to their greater bargaining power and to the worsening terms of trade in developing countries. Advocates of South-South trade argue that intra-trade in developing countries would contribute to a more equitable distribution of trade gains.
- Third, a crowding out effect: with their high technology, Northern producers have the capacity to produce good quality of products from new technologies. Since developing countries have not access to some technologies, they will become a simple consumer of many industrial products, which will prevent the creation of some categories of manufacturing firms.

As a result, the 2000s were marked by the emergence of developing countries intra-trade, specifically, trade between China and developing countries. China implemented an economic diplomatic targeting several dimensions: trade, financial flows and special economic zones... China became the main trade partner of Africa. Over the last decades, special attention has been paid to the role of Chinese emergence in other countries' economic prosperity both in media headlines and in scientific world. For example, for every 1% of economic growth in China, about 7.7 million people outside China would move out of poverty (Garroway et al., 2012). A part of this growth could result from manufacturing sector expansion, highlighting the potential of China in the industrialization of Africa. Indeed, Lin explains that a reallocation of a small proportion of the 85 million labor-intensive manufacturing jobs in China to Africa will be a boon to African industrialization, since manufacturing employment in that region is estimated at 10 million jobs (Lin, 2011*a*).

This paper studies the impact of trade with China on industrialization in Africa. In addition, we show the particularities of Africa compared to other developing countries (ODC), including those in Asia. In the sample of ODC we consider countries classified by the International Monetary Fund as low income economies and emerging economies. To the best of our knowledge, we are the first to make such a comparison that highlights a number of heterogeneities in South-South trade. Based on theoretical assumptions, we first discuss the conditions under which South-South trade can be a source of industrialization or a source of deindustrialization. Second, descriptive statistics are mobilized to understand the evolution and the nature of Chinese trade in Africa and in ODC. Third, empirical estimation is applied to study the effect of trade with China on industrialization in Africa and in ODC. For this purpose, we consider 53 African countries and 98 developing countries excluding Africa (78 emerging economies and 20 low income economies) between 1995-2021.

The impact of China's trade on the industrial sector of all developing countries depends on the content of these trade flows.[1] Therefore, international trade can have a positive or negative impact on industrialization. Indeed, we argue that commodities' exports and imports of finished manufactured goods adversely affect industrialization. In contrast, exports of finished manufactured goods and imports of intermediate inputs as well as physical capital have a beneficial impact on industrialization. Regarding the negative impact of exports, the assumption is that Africa and ODC commodities exports to China crowd out the manufacturing sector. In the case of the negative impact of imports, we assume that manufacturing

[1] In this paper, the industrial sector represents only manufacturing sector.

imports put competitive pressure on manufacturing firms in developing countries. From the channel of technology transfer and lower production costs, the impact of manufacturing exports and that of input imports should be positive.

Our results show that trade with China is a source of deindustrialization in Africa on both exports and imports side. However, although it is a source of industrialization for other developing countries on exports side, it is a source of deindustrialization on imports side. Thus, in terms of exports to China, our results show that Africa is a special case compared to other developing countries. More precisely, we find that the impact of aggregate exports is through heavy dependence on commodities exports to China.

Finally, the rest of this paper is organized as follows: Section 6.2 discusses how international trade can affect industrialization. Section 6.3 makes comparison between the influence of China's trade and that of developed countries in Africa. Section 6.4 and Section 6.5 describes variables, data and the empirical approach. Section 6.6 presents the results and Section 6.7 concludes.

6.2 How international trade with China can affect industrialization?

The aim of this paper is to study how trade with China could affect industrialization in Africa and in ODC. The question is how the two directions of trade (exports and imports) positively or negatively influence the process of industrialization. The sign of the impact of these two channels depends strongly on their content (raw materials, finished manufactured goods, intermediate inputs and/or physical capital). Thus, this section discusses the negative and positive effects of exports and imports on industrialization.

6.2.1 Negative impact of international trade on industrialization

This subsection explains how international trade can negatively affect industrialization by presenting the negative impact of exports and imports on the manufacturing sector.

Negative impact of exports on industrialization

According to the Dutch disease and resource curse theories, an export boom in the resource sector leads to deindustrialization through several channels. Although both Dutch disease and the resource curse highlight the negative impact of commodities exports on industrialization, the transmission channels remain different. Since the resource curse theory is more general (referring to institutional determinants in addition to exchange rate appreciation as transmission channels), the Dutch disease is often considered as a channel of the resource curse rather than as a specific theory. At the beginning of the 1980s, many theoretical papers studied Dutch disease issue (Bruno & Sachs, 1982; Buiter & Purvis, 1980; Corden & Neary, 1982; Corden, 1984; Van Wijnbergen, 1984). Nevertheless, the "Corden-Neary" model is generally used as the theoretical basis for most empirical studies. Considering a small open economy with three economic sectors (resource sector, tradable sector, non-tradable sector) a number of assumptions are made in the model.[2] The authors highlight two effects of the export boom in the resource sector: spending effect and resource movement effect.

- **Spending Effect**: As the boom of natural resources exports generates additional income, the demand for tradable and non-tradable goods will increase. However, since supply is fixed in the short term and the price of tradable goods is set on the international market, this will result in higher prices for non-tradable goods and higher import demand for tradable goods. Moreover, knowing that the return on capital will increase in the non-tradable sector,

[2]The hypotheses are related to the mobility of production factors (labor and capital), the equilibrium of trade, full employment and the flexibility of real wages.

wages will rise in both sectors (because of the perfect mobility of labor) leading to a fall in profit in tradable sector. Thus, the main consequence of the spending effect is real exchange rate appreciation due to inflation which in turn leads to exports competitiveness deterioration involving a slowdown in natural resources sector and a boom in non-tradable sector.

- **Resource-Movement Effect**: Since wages rise in the booming sector, there will be labor movement from the tradable and the non-tradable sectors to natural resources. This will reduce output in the non-booming sectors (tradable and non-tradable sectors). The economy will thus be faced with a continuous decline in supply in the non-booming sectors which will create a gap between supply and demand in these sectors. To restore the balance between supply and demand, imports of tradable goods must increase and prices will rise in the non-tradable sector because it is not substitutable with imports. This will create a new episode of inflation which will lead to an appreciation of the real exchange rate. Real exchange rate appreciation will generate a new movement of labor from the tradable sector to the non-tradable sector generating a process of deindustrialization.

  The Corden-Neary model is based on the hypothesis of a short-term shock in resource exports that makes supply constant in the spending effect. However, specialization in resource exports can also have a deleterious impact on the long-term evolution of the manufacturing sector.

- **Long-Term Effect**: As mentioned by Kaba et al. (2022), for developing countries with a weak manufacturing sector and with a lack of infrastructure, exports of raw materials create an incentive for import activities. It becomes more profitable to imports manufacturing goods than to locally produce them because of poor quality and lack of infrastructure. At the same time, countries that use export rents to solve the infrastructure deficit should make manufacturing activity more profitable and thus encourage economic agents to enter this sector at the expense of import activities. Hence, the long-term negative impact of the specialization in natural resource exports to China will depend on how states invest the export revenues in improving the quality and availability of infrastructure.

Negative impact of imports on industrialization

Theoretically, if imports are mainly made up of finished manufacturing products, they can have a negative impact on the local manufacturing sector. Indeed, competition from foreign products puts pressure on local manufacturing firms. As a result, the less competitive firms may leave the domestic market or lose market share, leading to a decline in the share of manufacturing value added in GDP or total value added and employment in total employment. Empirically, a wave of literature highlights this impact through an exposure index of countries to Chinese trade. For the first time, David et al. (2013) show that the more the United States (U.S.) is exposed to imports of manufactured goods from China the more manufacturing employment declines in the U.S. Indeed, U.S. exposure to the competition from Chinese manufacturing imports explained 33% of the decline in manufacturing jobs between 1990-2000, 55% between 2000-2007 and 44% between 1990-2007 (David et al., 2013). Moreover, exposure to competition from Chinese manufacturing products' imports leads to a decline in manufacturing employment in France, Norway, and Spain (Malgouyres, 2017; Balsvik et al., 2015; Donoso et al., 2015). Precisely, a 1,000 dollar increase in the exposure index to Chinese imports per worker leads to a 6.2% drop in manufacturing employment growth in France (Malgouyres, 2017). In addition, an exposure of the Norwegian labor market to competition from Chinese manufacturing products' imports explained more than 10% of the reduction in manufacturing employment between 1996-2007 (Balsvik et al., 2015). In the case of Africa, between 2004 and 2008, 17 Nigerian manufacturing industries would have succumbed to competition from Chinese manufacturing imports, six of them employing more than 1,000 people (Bräutigam & Tang, 2014). In Ethiopia, many firms in the informal sector have suffered from Chinese imports competition (Bräutigam & Tang, 2014). For ODC like Mexico and Chile, Mendez (2015) and Álvarez & Claro (2009) find that manufacturing products imports from China increase the probability of exit and reduce manufacturing employment growth.

6.2.2 Positive impact of international trade on industrialization

This subsection explains how international trade could positively affect industrialization by presenting how exports and imports may positively impact the manufacturing growth process.

Positive impact of exports on industrialization

Unlike the case of commodities' exports, if exports are mainly made up of manufactured goods, they can positively affect industrialization. For an economy, exports represent the external sale of a part of domestic production. If foreign demand for domestic products increases or if the share of foreign-oriented domestic production increases for any reason, domestic exports, especially exports from the largest exporting sector will increase. If exports are mainly made up of manufacturing products, manufacturing output will increase relative to other sectors leading to industrialization. The most illustrative example of the role of manufacturing exports in economies' industrialization process is the Asian miracle. Indeed, according to Page (1994), the eight most successful East Asian countries in terms of industrialization - Japan, Hong Kong, the Republic of Korea, Singapore, Taiwan, Indonesia, Malaysia, and Thailand - have all implemented exchange rate devaluation policies to support the manufacturing export growth. The consequence of such a policy has been an increase in the share of East Asian countries in the world trade. Indeed, these 8 countries recorded an increase in their share of world exports from 7.9% in 1965 to 13.1% in 1980 and 18.2% in 1990, respectively. The contribution of manufacturing exports in global exports growth was the most important in the trade performance of these countries. Between 1965 and 1990, Japan became the largest exporter of manufactured goods in the world, increasing its share from 8% to 12% between 1970 and 1980. The global share of manufacturing exports of the four tigers has increased almost four times faster than Japan. Indonesia, Malaysia, and

Thailand also experienced a similar increase in manufactured products exports.

Although the above discussion is based on macroeconomic analysis, a number of papers carry out comparative studies between the performance of exporting and non-exporting companies. This second wave is divided into two main work groups. The first, based on the U.S., Colombia, Morocco, and Spain (Delgado et al., 2002; Isgut, 2001; Bernard & Jensen, 1999; Clerides et al., 1998) concluded that manufacturing exporting firms are more productive than non-manufacturing exporters. Some authors argue that this difference in productivity is not explained by any advantage related to export activity but, by the fact that it is the most productive firms that undertake export activities. There would therefore be self-selection because only companies that are sufficiently productive to be competitive in foreign markets and able to pay transport costs undertake export activities. In this context, industrialization will be explained by an increase in the number of companies sufficiently productive to invest in the manufacturing sector in order to export finished products. The second group of studies (Fafchamps et al., 2007; Van Biesebroeck, 2005; Greenaway et al., 2002; Aw et al., 2000; Bigsten et al., 2000; Kraay, 1999) focusing on China, Cameroon, Ethiopia, Ghana, Kenya, Morocco, Tanzania, United Kingdom, Zambia and Zimbabwe, concluded that exports generate a process of learning by doing. According to these authors, even if it is the most productive firms that export, exporting firms improve their productivity as soon as they start exporting. Exports improve firms' productivity through the adoption of international best practices, good production techniques and interaction with customers in countries to which they export (Van Biesebroeck, 2005).

Positive impact of imports on industrialization

Although in some cases they can fuel competition in the domestic economy and push some local manufacturing firms out of the market, in some other circumstances, imports can have a positive impact on industrialization. Theoretical studies such as Grossman & Helpman (1991), Markusen (1989), Romer (1987), Ethier (1982) show that access to more varieties of intermediate inputs leads to productivity growth for firms importing these goods. Thus, two effects are to be noted. First, an expansion in imports of intermediate inputs to which the economy already had access increases the production of manufacturing goods initially available in domestic economy. Second, the access to new varieties of intermediate inputs initially unavailable in the economy leads to an increase in the production of new varieties of domestic finished products. Studies such as Halpern et al. (2015) Goldberg et al. (2010), Amiti & Konings (2007), empirically establish the positive impact of intermediate input imports on productivity. Indeed, imports of intermediate input accounted for 30% of total factor productivity growth in Hungary and about 50% of this effect was explained by the increase in the productivity of importers (Halpern et al., 2015). In the case of India, lower tariffs have led to higher imports of new varieties of inputs, which in turn have accounted for 31% of new varieties production (Goldberg et al., 2010). This group of papers explains that trade openness allows access to new varieties of intermediate inputs reducing technological constraint of the local manufacturing sector. In the long run, progressive access to different varieties of high-tech input allows the domestic manufacturing sector to experience a long run productivity growth.

6.3 China's trade influence in Africa and the nature of Africa-China and ODC-China trade

This section present China's trade influence in Africa and the nature of trade between China and the two areas of interest. Before discussing differences that result in the nature of trade between Africa-China trade and ODC-China trade, it is important to analyze the evolution of China's trade influence in Africa. Indeed, the debate on the growing market share of China in Africa at the expense of Western countries is increasingly attracting the attention of policy makers in the three areas.[3]

[3] The three areas: Africa, China and Western countries.

6.3.1 China in Africa myth or reality?

The share of China in Africa total exports and total imports was from 1.09% and 2.52% in 1995 to 16.75% and 19.90% in 2021, respectively (UNCTAD). Thus, the objective of this part is to make comparison between the evolution of developing and developed countries trade influence in Africa, with emphasis on the case of China. In 1995, the share of developed countries in Africa commodities exports was about 80% while that of developing countries was about 20% (Figure 6.1). In the same year, the share of developed countries in African manufacturing imports was just under 80% while that of developing countries was less than 30% (Figure 6.1). Over time, there has been a catching-up process, the share of developing countries in African trade has steadily increased in contrast to that of developed countries (Figure 6.1). In 2021, Africa traded more with developing countries than developed countries. So, what role does China play in the rise of trade between ODC and Africa? Indeed, China accounted for more than 30% of African manufacturing imports from developing countries in 2021 (Figure 6.1). In addition, the share of China in African commodities exports to developing countries was 29% in 2021. It should be noted that the share of China in African manufacturing exports to developing countries is still very low. Another way to understand China's trade influence in Africa is to compare it to the former colonizers of African countries. This comparison is relevant in the sense that, after their independence, most of African countries maintained - sometimes several years after independence - economic and trade relations with their former colonial powers. Despite the historical connection, currently, China trades more with African countries than their former colonizers it (Figures 6.2). Progressively since the beginning of the 2000s, British, Belgian and finally French colonies began to trade more with China than with the former colonial power.

6.3.2 The nature of South-South trade, is Africa a special case?

This section is the core of the analysis in this paper. Indeed, one of the key arguments of South-South trade theory is the diversification of trade among developing countries. Thus, one would expect imports from China and exports from ODC and Africa to China to be less concentrated. To test this hypothesis, it is important to analyze the content of Chinese exports and imports in relation to these two regions of interest. Indeed, not only the size of trade between Africa and China matters, but also the nature of that trade. In 2021, more than 90% of Africa's exports to China were made up of commodities and more than 90% of its imports from China were made up of manufactured goods (Figure 6.3). This fact shows that in Africa-China trade, the first is fully specialized in commodities export and manufacturing import. It should also be noted that commodities' imports from China to Africa (7.24%) are higher than African manufacturing exports to China (6.32%). On the contrary, the share of manufacturing products in exports from ODC to China is almost 60% while that of commodities is 40% (Figure 6.3). However, there is a similarity between Africa-China and ODC-China trade in terms of imports. Like African countries, more than 90% of imports from China to ODC are made up of manufactured goods. As a result, the exports from ODC to China are more diversified than that from Africa and than Chinese imports to the two regions.

Taking China as the benchmark country of the South, the above statistics highlight two important facts. First, the theory that intra-trade in developing countries would diversify imports is neither verified in Africa nor in the ODC. With the high concentration of Chinese exports of manufacturing goods in Africa and in ODC, imports from China could be a source of deindustrialization in the two regions. Second, South-South trade is diversified in terms of exports only in the case of trade between ODC and China. For Africa-China trade, exports are still heavily concentrated in natural resources. This shows that Africa does not verify the South-South trade theory. One could therefore argue that Africa's exports to China would be a source of deindustrialization in Africa while those from ODC to China would be a source of industrialization as over half of them are made up of manufacturing products. Although the above graphs can show whether trade with China is diversified or not, they do not permit an empirical conclusion on whether Chinese trade is a source of deindustrialization or industrialization. Therefore, econometric estimates are made below to understand the link between Chinese trade and industrialization in Africa and in ODC.

6.4 Variables and data description

- **Industrialization:** Industrialization represents the dependent variable and it is determined as manufacturing value added share in total value added. In order to allow comparison between countries and to control the effect of inflation, manufacturing value added and total value added are both in constant 2010 dollar prices (United Nations Statistics Division database).

- **Africa-China and ODC-China Trade:** The variables of interest are merchandises exports from Africa or ODC to China and merchandises imports from China to Africa or ODC. The variable «Exports» is the share of merchandises exports from Africa or ODC to China (as a percentage of GDP). The variable «Imports» is also the share of merchandises imports from China to Africa or ODC (as a percentage of GDP). In order to study the channels through which exports and imports impact industrialization, we break down the two variables into commodities and manufacturing products' exports/imports. About commodities, the variable «Primary commodities, Precious Stones and Non-monetary Gold Exports» is used. It follows the standard international trade classification (SITC) and contains all the commodities in the «SITC 0 + 1 + 2 + 3 + 4 + 68 + 667+ 971». For manufacturing products, the variable «Manufactured goods» including all the manufactured goods in the «SITC 5 to 8 less 667 and 68» is also used (United Nations Conference on Trade and Development database).

- **Real exchange rate overvaluation:** According to Rodrik (2008) and McMillan & Rodrik (2011), in developing countries, real exchange rate undervaluation and overvaluation positively and negatively impact manufacturing sector's competitiveness, respectively. Referring to these authors, we study the impact of real exchange rate overvaluation on industrialization. To do so, the overvaluation index «overvalue» is constructed in three steps following Rodrik (2008). The "price level of GDP" from the Penn World table 9.1 is used as the real exchange rate measurement. Indeed, according to Rodrik (2008), this variable is equivalent to the real exchange rate (RER) and it is expressed as one unit of local currency against an amount of dollar which allows to construct an overvaluation index rather than undervaluation contrary to Rodrik (Penn World table 9.1).

- **Market Size:** According to Murphy et al. (1989*a*), in developing countries, market size positively impacts industrialization if the national income is concentrated in the hands of the middle class which is the class that consumes industrial products the most. Empirically, like a number of papers on industrialization (Rodrik, 2016*a*; Gui-Diby & Renard, 2015; Kang & Lee, 2011; Kaya, 2010; Rowthorn & Ramaswamy, 1999) we use GDP per capita and population as market size measures «Market size» (United Nations Statistics Division (UNSD) database).

- **Total Employment % Population:** In addition to be important for industrialization in terms of factor of production, employment plays an important role in industrial specialization. For developing countries (including Africa) rich in low cost labor, the comparative advantage is in the production of labor intensive manufacturing goods. To take into account this comparative advantage effect, the impact of employment is controlled (World Bank database).

- **Public investment:** According to Newman et al. (2016), an important element of post-independence industrial strategy in Africa was massive public investment in state-own industries. In addition, according to Dorosh & Thurlow (2014), public investment in cities positively affects structural change leading to industrialization in some African countries. So, noted «Public investment», the share of public investment in GDP is used to take into account public intervention (International Monetary Fund database).

- **Private investment:** According to the big push theory, the transition of firms from the traditional to the modern sector can take place if private investment is simultaneous with coordination provided by the state. Moreover, number of empirical studies (Kang & Lee, 2011; Kaya, 2010; Rowthorn & Ramaswamy, 1999) find that investment has a positive impact on industrialization. However, in the dutch disease context, resources are directed towards natural resources sector. As illustration, Gui-Diby & Renard (2015) find that investment negatively impacts industrialization in Africa. Thus, «Private investment» as percentage of GDP is used in the econometric model (International Monetary Fund database).

- **Trade protection and financial restriction polices:** Developing countries, in their economic history, have often experienced two types of trade and financial policies. First, the end of 1950s has been marked by economic measures of self-reliance to ensure the econonmic independence from former colonizers. Governments have thus put in place trade protection and financial restriction policies. These trade and financial measures were intended to allow the creation and the protection of local industries. While these economic measures effectively allowed the emergence of state-owned industries, their unsustainability led to inefficiency in the case of African countries (Newman et al., 2016; Kaba et al., 2022). Second, the 1980s were characterized by a wave of trade and financial openness in these countries. According to Meier et al. (1989), trade and financial openness in relation to structural adjustment programs of international institutions led to deindustrialization in numerous African countries.

  In this context, we use in our empirical model an indicator of trade protection policies consisting of the following measures: trade regulations, trade taxes, tariffs, trade agreements. The indicator of financial restrictions is determined from the measures of: investment restrictions, capital account openness, international investment agreement. These two variables come from the KOFF Swiss Economic Institute database (trade globalisation, de jure; financial globalisation, de jure).

- **Agriculture value added in total value added:** According to the structural change theory, the movement of resources from the traditional sector (agriculture) to the modern sector (manufacturing) leads to a growth of the manufacturing sector (Gui-Diby & Renard, 2015; Lin, 2011*a*; Lewis, 1954). Thus, the effect of structural transformation is controlled by the share of the agricultural value added in total value added (United Nations Statistics Division database).

6.5 Empirical strategy

In this paper, the ordinary least square (OLS) with country and year fixed effects is used as estimate approach to study the link between Chinese trade and industrialization in Africa and in ODC. The OLS with country and year fixed effects is relevant in the sense that it allows to consider one dimension of endogeneity namely the issue of omitted variables. Controlling for country and year fixed effects helps to capture the country and year specific characteristics that can affect industrialization. Not controlling for the country and year heterogeneities leads to an omitted variable bias since these variables will end up in the error term. If the omitted variables are correlated to the explanatory variables, it will result in a correlation between the error term and the variables of interest (endogeneity). To circumvent the other dimension of endogeneity, which is the reverse causality, we use lagged values (t-1) of all explanatory variables. In a macro-econometric model, variables (explained and explanatory variables) are explained by each other. As mentioned above, trade with China can either positively or negatively affect industrialization. However, manufacturing growth can promote trade with China, especially through exports of manufactured goods and imports of intermediate inputs. In addition, the expansion of the manufacturing sector due to local processing of raw materials may reduce commodities' exports to China. To take into account these reverse causalities between industrialization and trade with China, we regress the instantaneous industrialization on trade one year ago. Also, we lag all of the explanatory variables by one year to ensure that a potential reverse causality between them and industrialization does not bias the estimates.

In addition to the endogeneity issue, the problem of spurious regression - due to the non-stationarity of variables in the model - can affect the quality of estimates from a panel with an important time dimension like ours. In fact, most of the macroeconomic variables are not stationary in level (they have unit roots in level). To avoid this problem, it is often recommended to consider the first differences of any variables in the model that contain unit roots in level. However, estimating a model with first difference variables highlights the short-run effects of explanatory variables on the dependent variable. In our case, the aim is to study the long-run effects (variables in level) on industrialization. In this context, the spurious regression due to the existence of unit roots is addressed by considering a model that includes the lagged explanatory variables as well as the lagged explained variable. The model can be written as follows :

$$Industrialization_{i,t} = \beta Exports_{i,t-1} + \sigma Imports_{i,t-1} + \gamma X_{i,t-1} + Industrialization_{i,t-1} + \delta_i + \theta_t + \nu_{i,t} \tag{6.1}$$

The variable $Exports_{i,t-1}$ is the share of total exports to China one year ago in percentage of GDP while $Imports_{i,t-1}$ is the share of total imports from China one year ago in percentage of GDP. To study the transmission channels, exports and imports are decomposed into commodities and manufacturing exports/imports. The vector $X_{i,t-1}$ represents the set of control variables (lagged). δi and θ_t are the country and year fixed effects, respectively while $\nu_{i,t}$ is the idiosyncratic error term.

6.6 Results

This section presents findings on the effects of trade with China on industrialization in Africa and in ODC namely low-income economies and emerging economies.

Table 6.1 reports results for the African sample. In column 1, we consider only African exports to China and imports from China as explanatory variables. The control variables are introduced in column 2. Then, explanatory variables that may be strongly correlated to trade with China are introduced gradually. Considering exclusively exports and imports, only African exports to China negatively and significantly affect industrialization (column 1). In the presence of control variables, the impact of exports remains negative and significant while that of imports is insignificant though negative (column 2). From column 3 to column 6, the introduction of trade protection policies, financial restrictions and the agricultural value added, the coefficients of exports and imports slightly modify. However, the effects of exports remain negative and significant and those of imports become significant. Furthermore, by introducing industrialization delayed by one year (column 7), the coefficients on exports and imports fall sharply, although they remain significant.

Table 6.2 describes the results for the sample of low income economies. As in Table 6.1, only exports have a significant and negative impact on industrialization in the column 1. However, once the control variables are introduced, the effect of exports becomes positive and significant while that of imports becomes negative and significant (column 2). Similar to Table 6.1, the coefficients of imports and exports fall drastically after the introduction of the industrialization variable lagged by one year (column 3-7). In the case of emerging economies, the effect of exports and imports are respectively positive, negative and significant simultaneously in columns: 3; 4; 5 and 6 (Table 6.3). Considering the effects of industrialization lagged by one year, exports and imports no longer significantly affect industrialization in emerging economies.

From the above results, it appears that trade with China does not affect developing countries in the same way. Indeed, total exports to China are source of deindustrialization in Africa (negative effect) whereas they are source of industrialization in low income economies and emerging economies (positive effect).[4] However, total imports from China appear to have negative and significant effects on

[4]Note that for emerging economies, the positive and negative effects respectively of exports and imports are not significant.

industrialization both in Africa, low income economies and emerging economies. The difference between the effects of total exports in Africa and in ODC may be explained by the nature of exports. As shown in Figure 6.3, more than 90% of exports from Africa to China are made up of commodities while 60% of exports from ODC to China are made up of manufacturing goods. Thus, the concentration of African countries in commodities' exports crowding out manufacturing sector could explain why exports are source of deindustrialization in Africa. Moreover, these results show that the argument that South-South trade diversifies exports to be a source of industrialization is not empirically valid in Africa, although it is in ODC. This make Africa a special case in South-South trade.

Since the negative effect of total exports from Africa to China is explained by the specialization of African countries in commodities' exports, the overall export is decomposed into commodities and manufacturing exports to China. Table 6.4 reports results of the effects of commodities and manufacturing products' exports. From column 1 to column 4, results show that the share of commodities exports to China in total exports to China has a negative and significant impact on industrialization in Africa, while that of manufacturing exports is not significant. The present results confirm previous analyses by showing that the negative effect of total exports on industrialization in Africa is due to specialization in commodities exports. Note that our main objective is to understand the sign of the impact of trade with China. The low coefficients of commodities exports are due to the fact that in addition to commodities exports to China, trade with many other countries affects industrialization in Africa.

6.7 Concluding remarks

This paper shows that the idea that South-South trade would contribute to export diversification for each trading partner involving their industrialization is not empirically validated in the case of Africa although it is verified for other developing countries. Indeed, we find that trade with China is a source of deindustrialization in Africa on the aggregate exports side while it is a source of industrialization in other developing countries. In the case of Africa, the underlying mechanism of aggregate exports impact is through heavy dependence on commodities exports to China. Thus, one of the challenges associated with Africa's industrialization is to transform the nature of its trade with China to make it a source of industrialization.

Given that trade with China is a source of deindustrialization in Africa, the question is how Africa can take advantage of this trade to industrialize. Africa could have both advantage in its imports and exports with China. On the import side, African governments have to put in place trade policies aimed at reducing the cost of importing intermediate inputs and physical capital from China. This will reduce the costs of investment in manufacturing firms by reducing the part of investment's cost associated with capital and input. Consequently, the economic costs of the infrastructure deficit in these countries will be reduced. On the exports side, African governments have two possibilities which seem to be alternative. First, wage rate is increasing in China so governments could attract Chinese firms to locally process commodities imported by China from African countries. However, in some economies of this continent, the quality of infrastructure and institutions generates production losses in industrial firms. Thus, African governments should provide incentives such as special economic zones in which all the conditions for manufacturing activities are required. Second, as it is already the case in some African countries, governments can trade commodities against the construction of road and electricity infrastructure by Chinese firms that will eventually reduce the economic cost of investment in the industrial sector. However, such trade can be beneficial for African countries if the contracts are structured in such a way that the amount of raw materials extracted corresponds to the amount of investment in infrastructure by Chinese companies. There is another condition which is the equity between China and African countries in each contract. In any case, institutional issues (respect for the law, the fight against corruption, etc.) remain fundamental and are still far from being resolved.

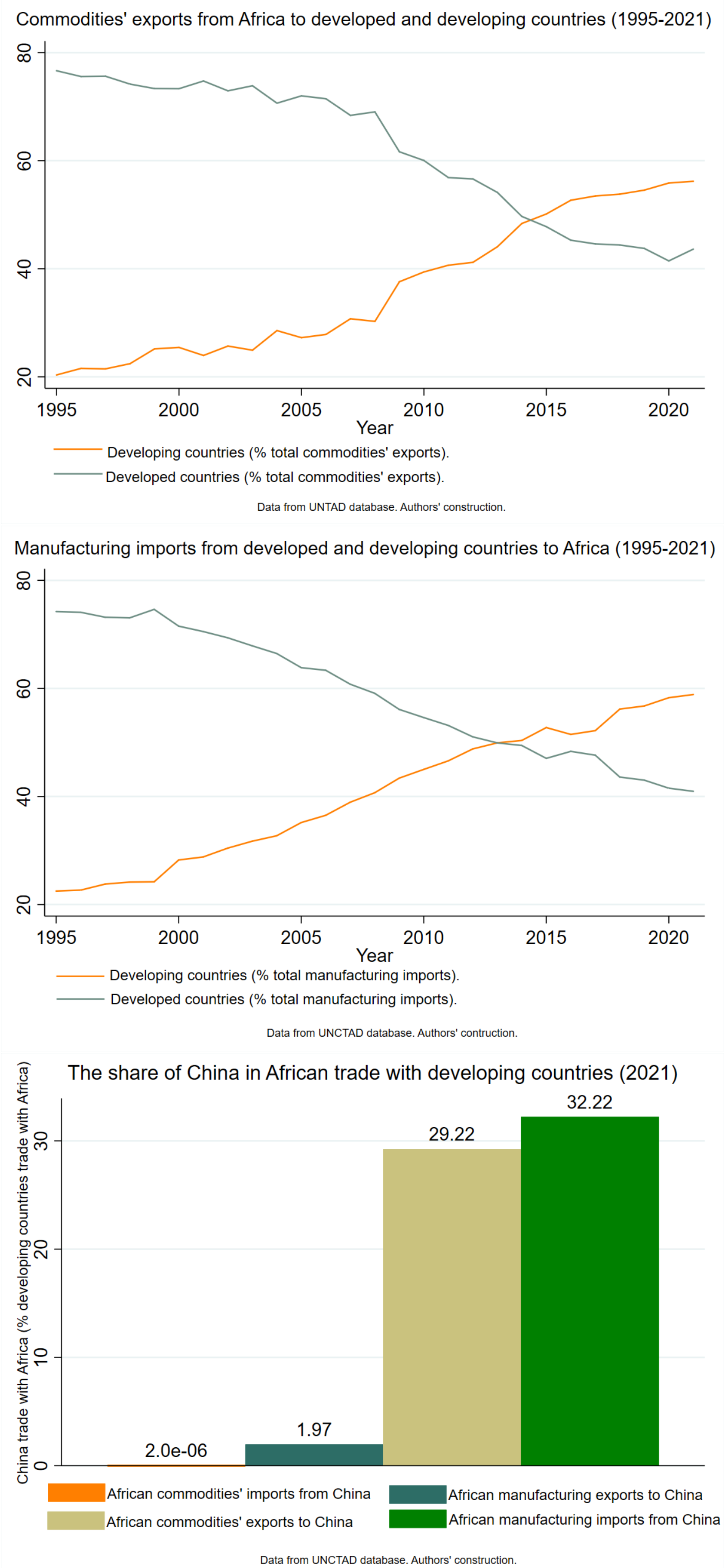


Figure 6.1: The share of developed and developing countries in African trade

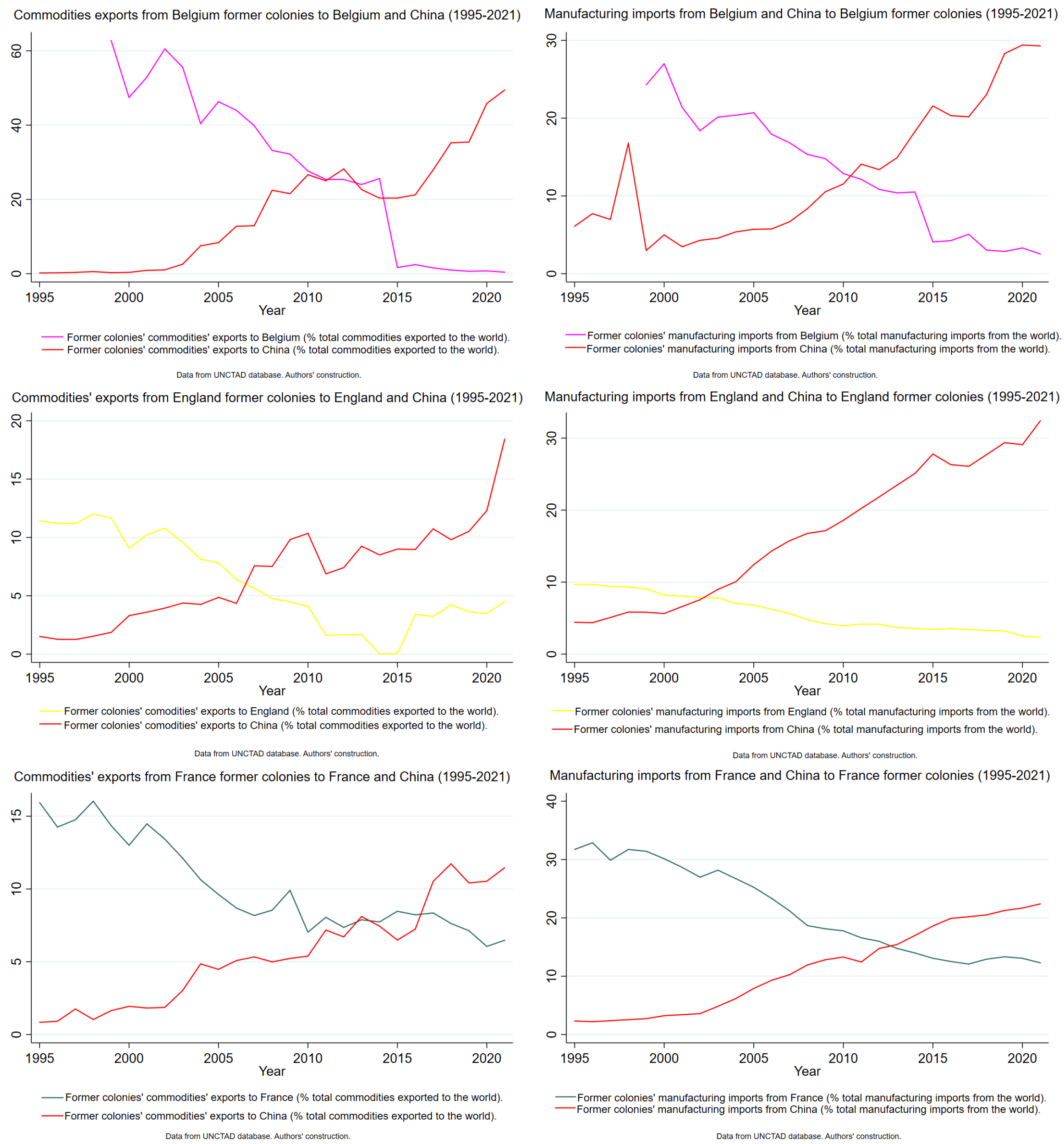


Figure 6.2: The share of China and former African colonizers in African trade (1995-2021)

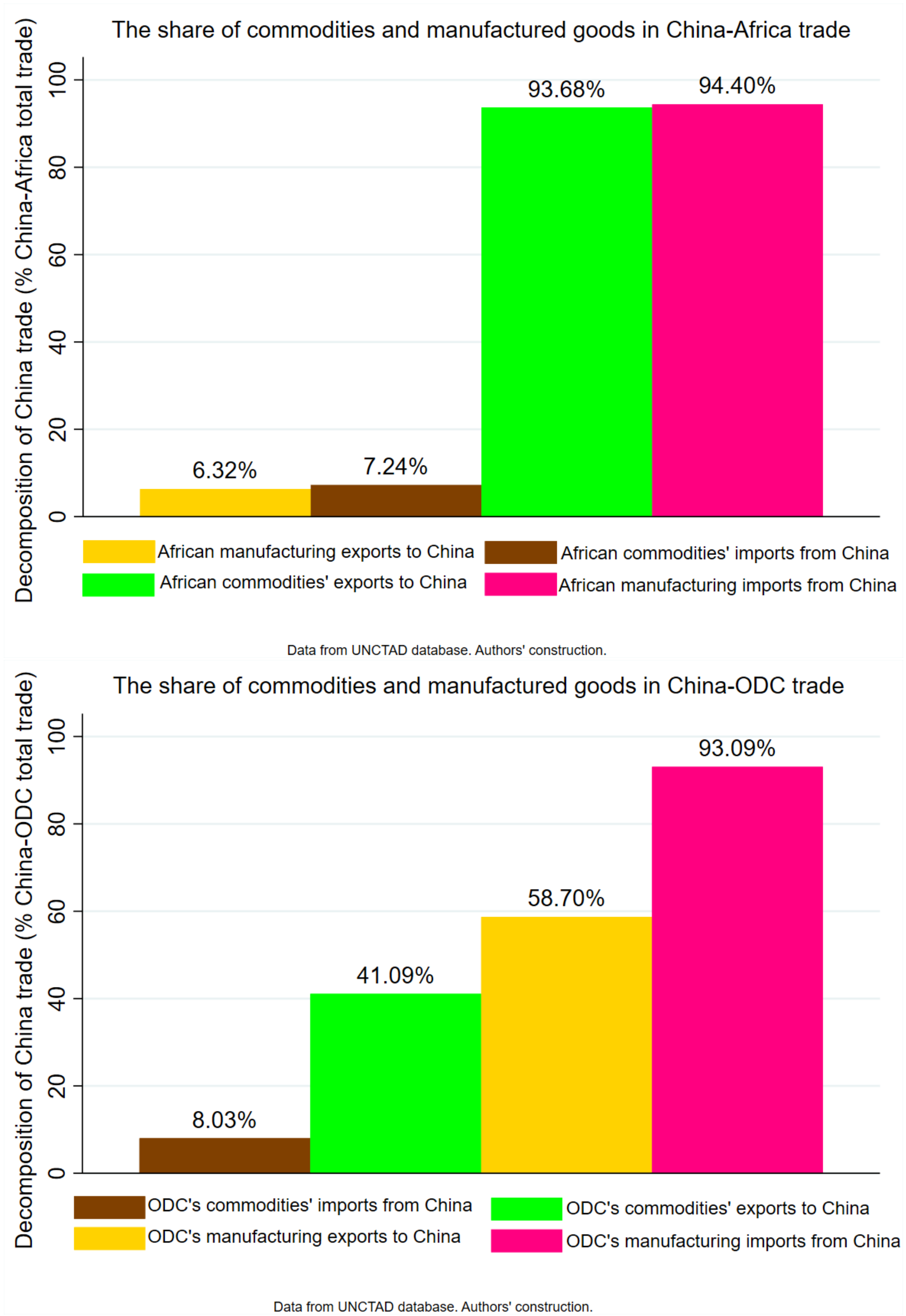


Figure 6.3: The nature of trade between Africa and China (2021) vs the nature of trade between ODC and China (2021)

Table 6.1: The effects of China's trade on industrialization in Africa (% GDP)

	Africa						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Exports % GDP (t-1)	-0.003*	-0.004**	-0.021***	-0.021***	-0.021***	-0.023***	-0.003**
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)
Imports % GDP (t-1)	-0.045	-0.076	-0.261***	-0.261***	-0.261***	-0.240***	-0.078**
	(0.036)	(0.047)	(0.052)	(0.052)	(0.051)	(0.051)	(0.035)
Market Size (t-1)		-0.000	-0.001***	-0.001***	-0.001***	-0.001***	-0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Private Investment (t-1)		-0.079***	-0.033**	-0.036**	-0.035**	-0.041**	-0.015
		(0.022)	(0.016)	(0.017)	(0.017)	(0.017)	(0.010)
Public Investment (t-1)		0.091***	-0.008	-0.011	0.002	-0.009	0.021
		(0.029)	(0.031)	(0.031)	(0.032)	(0.033)	(0.016)
Employment (t-1)		0.737***	0.830***	0.816***	0.844***	0.819***	0.111**
		(0.108)	(0.109)	(0.110)	(0.110)	(0.116)	(0.047)
Population (t-1)		-0.370***	-0.406***	-0.399***	-0.426***	-0.420***	-0.047*
		(0.055)	(0.056)	(0.057)	(0.060)	(0.062)	(0.025)
Trade Protection Policies (t-1)			-0.064***	-0.067***	-0.067***	-0.068***	-0.003
			(0.010)	(0.009)	(0.009)	(0.009)	(0.007)
Financial Restriction Policies (t-1)				0.021*	0.017	0.017	0.006
				(0.011)	(0.011)	(0.011)	(0.007)
Overvalue (t-1)					-3.761***	-4.046***	-0.618
					(1.256)	(1.237)	(0.524)
Agriculture Value Added (t-1)						-0.049*	0.018
						(0.025)	(0.015)
Industrialization (t-1)							0.833***
							(0.030)
Observation	1186.000	1106.000	1040.000	1040.000	1040.000	1040.000	1040.000
F-stats	3.075	10.250	28.325	26.506	24.833	24.710	153.445
R^2	0.884	0.887	0.911	0.912	0.913	0.913	0.976
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6.2: The effects of China's trade on industrialization in low income developing economies (% GDP)

	Low income countries						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Exports % GDP (t-1)	-0.018*	0.045***	0.041***	0.060***	0.058***	0.111***	0.016***
	(0.010)	(0.011)	(0.012)	(0.013)	(0.013)	(0.014)	(0.005)
Imports % GDP (t-1)	-0.099	-0.253**	-0.326**	-0.505***	-0.505***	-0.349***	-0.060*
	(0.098)	(0.115)	(0.128)	(0.134)	(0.134)	(0.104)	(0.031)
Market Size (t-1)		-0.002**	-0.001	-0.001	-0.001	-0.006***	-0.001***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Private Investment (t-1)		0.315***	0.304***	0.270***	0.268***	0.056	-0.004
		(0.061)	(0.064)	(0.059)	(0.058)	(0.038)	(0.015)
Public Investment (t-1)		0.231***	0.154*	0.000	-0.023	0.069	0.069***
		(0.083)	(0.086)	(0.089)	(0.094)	(0.076)	(0.023)
Employment (t-1)		0.592***	0.614***	0.566***	0.614***	0.764***	0.135**
		(0.191)	(0.191)	(0.182)	(0.186)	(0.160)	(0.061)
Population (t-1)		-0.170	-0.167	-0.111	-0.145	-0.140	-0.018
		(0.124)	(0.124)	(0.120)	(0.122)	(0.104)	(0.035)
Trade Protection Policies (t-1)			-0.044	-0.057	-0.058	-0.066***	-0.014
			(0.040)	(0.036)	(0.036)	(0.025)	(0.009)
Financial Restriction Policies (t-1)				0.151***	0.150***	0.031	-0.006
				(0.027)	(0.027)	(0.021)	(0.008)
Overvalue (t-1)					-3.906	-13.600***	-2.615**
					(3.420)	(3.144)	(1.217)
Agriculture Value Added (t-1)						-0.589***	-0.076***
						(0.053)	(0.028)
Industrialization (t-1)							0.846***
							(0.038)
Observation	417.000	308.000	295.000	295.000	295.000	295.000	295.000
F-stats	6.957	13.910	12.065	16.984	15.699	31.768	292.959
R^2	0.735	0.769	0.776	0.804	0.805	0.878	0.982
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6.3: The effects of China's trade on industrialization in emerging economies (% GDP)

	Emerging countries						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Exports % GDP (t-1)	0.002	0.001	0.005***	0.006***	0.005***	0.006***	0.000
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Imports % GDP (t-1)	-0.027	-0.074**	-0.071*	-0.082**	-0.104***	-0.119***	-0.025
	(0.033)	(0.033)	(0.037)	(0.036)	(0.034)	(0.034)	(0.017)
Market Size (t-1)		-0.000	-0.000	-0.000	-0.000	-0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Private Investment (t-1)		0.059***	0.063***	0.047**	0.032*	0.031*	0.006
		(0.019)	(0.020)	(0.019)	(0.017)	(0.017)	(0.010)
Public Investment (t-1)		0.022	0.027	0.036	0.009	0.007	0.005
		(0.027)	(0.031)	(0.030)	(0.027)	(0.028)	(0.012)
Employment (t-1)		-0.060***	-0.059***	-0.045***	-0.047***	-0.041**	-0.002
		(0.016)	(0.016)	(0.017)	(0.017)	(0.017)	(0.008)
Population (t-1)		0.026***	0.025***	0.021***	0.021***	0.016***	0.002
		(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Trade Protection Policies (t-1)			0.013	0.006	0.005	0.005	-0.000
			(0.008)	(0.008)	(0.008)	(0.008)	(0.003)
Financial Restriction Policies (t-1)				0.035***	0.031***	0.029***	0.006**
				(0.007)	(0.006)	(0.006)	(0.002)
Overvalue (t-1)					-0.458***	-0.464***	-0.147***
					(0.075)	(0.075)	(0.022)
Agriculture Value Added (t-1)						-0.094***	0.002
						(0.035)	(0.024)
Industrialization (t-1)							0.885***
							(0.016)
Observation	1594.000	1315.000	1269.000	1269.000	1269.000	1269.000	1269.000
F-stats	1.251	12.013	11.250	12.768	17.241	15.947	424.836
R^2	0.902	0.921	0.913	0.915	0.918	0.919	0.986
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6.4: The effects of Africa-China trade on industrialization in Africa (transmission channels).

	(1)	(2)	(3)	(4)
	Model 1	Model 2	Model 3	Model 4
Commodities Exports % Exports to China (t-1)	-1.40e-08***	-1.42e-08***	-1.43e-08***	-1.49e-08***
	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing Imports % Imports from China (t-1)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Commodities Imports % Imports from China (t-1)	0.006	0.005	0.004	0.006
	(0.009)	(0.009)	(0.009)	(0.009)
Manufacturing Imports % Imports from China (t-1)	0.003	0.003	0.002	0.003
	(0.008)	(0.008)	(0.008)	(0.008)
Industrialization (t-1)	0.841***	0.839***	0.838***	0.841***
	(0.032)	(0.032)	(0.032)	(0.032)
Market Size (t-1)	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Private Investment (t-1)	-0.014	-0.015	-0.015	-0.013
	(0.010)	(0.011)	(0.011)	(0.011)
Public Investment (t-1)	0.010	0.008	0.009	0.013
	(0.019)	(0.020)	(0.020)	(0.018)
Employment (t-1)	0.065	0.062	0.067	0.074
	(0.046)	(0.045)	(0.048)	(0.050)
Population (t-1)	-0.022	-0.021	-0.025	-0.026
	(0.024)	(0.023)	(0.025)	(0.026)
Trade Protection Policies (t-1)	0.001	0.000	0.000	0.001
	(0.008)	(0.007)	(0.007)	(0.007)
Financial Restriction Policies (t-1)		0.008	0.007	0.007
		(0.008)	(0.008)	(0.007)
Overvalue (t-1)			-0.501	-0.375
			(0.551)	(0.545)
Agriculture Value Added (t-1)				0.017
				(0.014)
Observation	950.000	950.000	950.000	950.000
F-stats	109.709	101.290	93.891	87.884
R^2	0.975	0.975	0.975	0.975
Country fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6.5: List of African countries

Country	Freq.	Percent	Cum.
Algeria	27	1.96	1.96
Angola	27	1.96	3.92
Benin	27	1.96	5.88
Botswana	27	1.96	7.84
Burkina Faso	27	1.96	9.80
Burundi	27	1.96	11.76
Cameroon	27	1.96	13.73
Central African Republic	27	1.96	15.69
Chad	27	1.96	17.65
Comoros	27	1.96	19.61
Congo	27	1.96	21.57
Cote d'Ivoire	27	1.96	96.08
Democratic Republic of the Congo	27	1.96	98.04
Djibouti	27	1.96	23.53
Egypt	27	1.96	25.49
Equatorial Guinea	27	1.96	27.45
Eritrea	27	1.96	29.41
Ethiopia	27	1.96	31.37
Gabon	27	1.96	33.33
Gambia	27	1.96	35.29
Ghana	27	1.96	37.25
Guinea	27	1.96	39.22
Guinea-Bissau	27	1.96	41.18
Kenya	27	1.96	43.14
Lesotho	27	1.96	45.10
Liberia	27	1.96	47.06
Libya	27	1.96	49.02
Madagascar	27	1.96	50.98
Malawi	27	1.96	52.94
Mali	27	1.96	54.90
Mauritania	27	1.96	56.86
Mauritius	27	1.96	58.82
Morocco	27	1.96	60.78
Mozambique	27	1.96	62.75
Namibia	27	1.96	64.71
Niger	27	1.96	66.67
Nigeria	27	1.96	68.63
Rwanda	27	1.96	70.59

Table 6.6: List of African countries (continued)

Country	Freq.	Percent	Cum.
Sao Tome and Principe	27	1.96	72.55
Senegal	27	1.96	74.51
Seychelles	27	1.96	76.47
Sierra Leone	27	1.96	78.43
Somalia	27	1.96	80.39
South Africa	27	1.96	82.35
Swaziland	27	1.96	100.00
Tanzania, United Republic of	27	1.96	84.31
Togo	27	1.96	86.27
Tunisia	27	1.96	88.24
Uganda	27	1.96	90.20
Zambia	27	1.96	92.16
Zimbabwe	27	1.96	94.12
Total	1,377	100.00	

Table 6.7: List of low income economies

Country	Freq.	Percent	Cum.
Afghanistan	27	5.00	5.00
Bangladesh	27	5.00	10.00
Bhutan	27	5.00	15.00
Cambodia	27	5.00	20.00
Haiti	27	5.00	25.00
Honduras	27	5.00	30.00
Kiribati	27	5.00	35.00
Kyrgyzstan	27	5.00	40.00
Moldova, Republic of	27	5.00	45.00
Myanmar	27	5.00	50.00
Nepal	27	5.00	55.00
Nicaragua	27	5.00	60.00
Papua New Guinea	27	5.00	65.00
Solomon Islands	27	5.00	70.00
Tajikistan	27	5.00	75.00
Uzbekistan	27	5.00	80.00
Viet Nam	27	5.00	85.00
Yemen	27	5.00	90.00
Laos	27	5.00	95.00
Timor-Leste	27	5.00	100.00
Total	540	100.00	

Table 6.8: List of emerging economies

Country	Freq.	Percent	Cum.
Albania	27	1.28	1.28
Antigua and Barbuda	27	1.28	2.56
Argentina	27	1.28	3.85
Armenia	27	1.28	5.13
Aruba	27	1.28	6.41
Azerbaijan	27	1.28	7.69
Bahamas	27	1.28	8.97
Bahrain	27	1.28	10.26
Barbados	27	1.28	11.54
Belarus	27	1.28	12.82
Belize	27	1.28	14.10
Bosnia and Herzegovina	27	1.28	15.38
Brazil	27	1.28	16.67
Brunei Darussalam	27	1.28	17.95
Bulgaria	27	1.28	19.23
Chile	27	1.28	20.51
Colombia	27	1.28	21.79
Costa Rica	27	1.28	23.08
Croatia	27	1.28	24.36
Dominica	27	1.28	25.64
Dominican Republic	27	1.28	26.92
Ecuador	27	1.28	28.21
El Salvador	27	1.28	29.49
Fiji	27	1.28	30.77
Georgia	27	1.28	32.05
Grenada	27	1.28	33.33
Guatemala	27	1.28	34.62
Guyana	27	1.28	35.90
Hungary	27	1.28	37.18
India	27	1.28	38.46
Indonesia	27	1.28	39.74
Iran (Islamic Republic of)	27	1.28	41.03
Iraq	27	1.28	42.31
Jamaica	27	1.28	43.59
Jordan	27	1.28	44.87
Kazakhstan	27	1.28	46.15
Kuwait	27	1.28	47.44
Lebanon	27	1.28	48.72
Macedonia	27	1.28	50.00
Malaysia	27	1.28	51.28
Maldives	27	1.28	52.56
Marshall Islands	27	1.28	53.85
Mexico	27	1.28	55.13

Table 6.9: List of emerging economies (continued)

Country	Freq.	Percent	Cum.
Mongolia	27	1.28	56.41
Nauru	27	1.28	57.69
Oman	27	1.28	58.97
Pakistan	27	1.28	60.26
Palau	27	1.28	61.54
Panama	27	1.28	62.82
Paraguay	27	1.28	64.10
Peru	27	1.28	65.38
Philippines	27	1.28	66.67
Poland	27	1.28	67.95
Qatar	27	1.28	69.23
Romania	27	1.28	70.51
Saint Kitts and Nevis	27	1.28	71.79
Saint Lucia	27	1.28	73.08
Saint Vincent and the Grena..	27	1.28	74.36
Samoa	27	1.28	75.64
Saudi Arabia	27	1.28	76.92
Sri Lanka	27	1.28	78.21
Suriname	27	1.28	79.49
Syrian Arab Republic	27	1.28	80.77
Thailand	27	1.28	82.05
Tonga	27	1.28	83.33
Trinidad and Tobago	27	1.28	84.62
Turkmenistan	27	1.28	85.90
Tuvalu	27	1.28	87.18
Ukraine	27	1.28	88.46
United Arab Emirates	27	1.28	89.74
Uruguay	27	1.28	91.03
Vanuatu	27	1.28	92.31
Venezuela	27	1.28	93.59
Bolivia	27	1.28	94.87
Russian Federation	27	1.28	96.15
Serbia	27	1.28	97.44
Turkey	27	1.28	98.72
West Bank and Gaza	27	1.28	100.00
Total	2,106	100.00	

Chapter 7

General Conclusion

This general conclusion is organized into two main ways. First, we summarize the research questions and findings of the part of this thesis Second, we outline avenues for future research on African industrialization.

7.1 Chapters' summary and findings

Although the key challenge for development economists is to find the secret formula for the economic prosperity of nations, there is still no consensus on the magic recipe for achieving economic development. While some authors emphasize the role of institutional quality, others identify geographic location as the main factor explaining the gaps in living standards between countries. Nevertheless, industrialization is the common characteristic of most advanced economies. In terms of industrial progress, sub-Saharan Africa is the most backward region in the world, which would explain its high level of poverty incidence. The need for this region to industrialize is becoming increasingly pressing as its population grows at a rapid pace. In this vein, the present thesis empirically investigates the effects of factors that explain industrialization in sub-Saharan Africa. Hence, after the General Introduction (Chapter 1), this dissertation is organized in two parts: internal and external determinants of industrialization.

The first part considers the electricity infrastructure as the main internal determinant of industrialization in sub-Saharan Africa. This choice is explained by the fact that the poor quality of electricity service is the most important constraint for manufacturing firms in Africa. Part 1 is divided in two Chapters. Chapter 2 examines the impact of the poor quality of electricity service on employment in manufacturing firms operating in sub-Saharan Africa. Using a measure of production losses due to power outages and the two-stage least squares approach, I use as instrument, the electricity losses during power transmission from the source of supply to the destination. The results show that output losses due to power outages reduce total employment in manufacturing firms. Moreover, only production workers are affected by the job reduction caused by production losses. In contrast, non-production workers are positively impacted by power outages. Dividing production workers into skilled and unskilled workers, it appears that both groups of employees are negatively affected by production losses. However, unskilled workers are more adversely influenced. Overall, temporary employees appear to be the most vulnerable to power outages. In addition, firms that rely on generators for more than 50% of their electricity consumption reduce employment more than others. In Chapter 3, I introduce the concept of intra-sectoral structural change. This is defined as the movement of manufacturing firms from the domestic to the export market. Such a structural transformation would be a source of economic development because the entry of a firm on the export market would increase production, employment, wages and thus the living standards of workers. Hence, in the present Chapter, I conduct a comparative analysis between policies aimed at promoting exports and the internal obstacles that prevent manufacturing firms from exporting. Considering real exchange rate undervaluation as an export promotion policy and power outages as internal constraints, the two-stage least squares method is applied. Temperature and precipitation shocks are used as instruments to address the endogeneity in the length of electricity shortages. The results reveal that the length of power outages has a negative effect on the share of sales that is exported by firms, while the effect on domestic sales is not significant. However, exchange rate undervaluation positively affects the share of exports in total sales without having a significant effect on the share of domestic sales. For comparison purposes, it appears that the negative effect of electricity shortages on the export share is far greater than the positive impact of exchange rate undervaluation. Also, the econometric estimates show collateral damage effects. Indeed, both power outages and undervaluation negatively influence the share of imported inputs in total input purchases while positively affecting the share of domestic inputs. The effect of power outages and that of undervaluation increase drastically in countries with poor access to electricity compared to those with better access to electricity. In addition, electricity shortages have a greater effect on non-innovative firms than innovative firms. For firms that rely heavily on self-generation, the effects of power outages and undervaluation are small compared to firms that do less self-generation. These results show that firms making efforts to introduce new production processes that could generate productivity gains and therefore competitive gains are less affected by power outages and exchange rate undervaluation. Also, firms that make efforts to reduce electricity shortages by producing a part of their electricity consumption are less affected by power outages and exchange rate undervaluation than those that do not make such efforts. Furthermore, manufacturing companies in non-resource-rich countries are more affected by power outages and undervaluation than those in resource-rich countries. Otherwise, it appears that when a country improves its access to electricity, the positive effect of undervaluation decreases. Undervaluation is therefore an effective subsidy for manufacturing firms only in the case of countries with low access to electricity. In summary, it can be noted that in addition to the collateral damage of undervaluation, the negative effect of power outages outweighs the positive effect of undervaluation.

The second part considers international financial flows and international trade as external determinants of industrialization in sub-Saharan Africa. It is structured in three main chapters. Chapter 4 analyzes the role of remittances in Africa's industrialization process. Given that FDI flows are, since 2015, less important than remittances flows, the latter are the main external sources of finance considered in this thesis. At the same time, FDI has failed to industrialize Africa as they are directed towards activities that crowd out the manufacturing sector. In particular, I study how remittances impact investment, sales, and employment of firms operating in sub-Saharan Africa. The two-stage least squares method is performed in order to correct for endogeneity bias in remittances. The instruments are: the cost of remittances and the employment rate of the foreign-born in interaction with emigration rates in OECD countries. The results suggest that remittances increase the share of capital held by nationals in manufacturing firms while this effect is not economically significant in non-manufacturing firms. In contrast, remittances have a positive impact on sales in non-manufacturing firms, while they negatively affect them in manufacturing firms. For employment, it rises as remittances increase in both manufacturing and non-manufacturing firms. A number of heterogeneity analyses highlight three interesting findings. First, remittances are mainly used for investment purposes in countries with low levels of financial development. Second, the investment-effect in manufacturing firms, the spending-effect in non-manufacturing and the employment-effect in the two groups of firms increase when resource-rich countries are excluded. Third, the impact of remittances on the share of capital held by nationals becomes positive when the aforementioned group of countries is excluded. These results indicate that, being less dependent on natural resources strengthens the impact of remittances on firm performance in sub-Saharan Africa. Fourth, remittances positively influence the share of capital held by nationals only in medium-sized firms. Fifth, the negative effect of remittances on manufacturing sales exists only in small firms. These results have several policy implications. First, the positive effect of remittances on investment suggests a productive use of remittances. This demonstrates that remittances can be a source of finance for the manufacturing sector, which faces enormous difficulties in accessing finance. However, the lack of impact in the non-manufacturing sector suggests the persistence of other challenges to entrepreneurship, such as business profitability, poor infrastructure (roads, electricity, etc.), bureaucracy and corruption. If these barriers are removed, the investment effect of remittances in this region can be substantial. Second, the negative effect of remittances on manufacturing sales indicates a substitution of foreign industrial products for domestic manufactured goods. This phenomenon mainly affects small manufacturing firms. Chapter 5 investigates the role of trade policy and trade openness, as well as that of industrial policies on inter-sectoral structural change in sub-Saharan Africa. Through an extensive theoretical discussion, I compare industrial and trade policies in Asia and Africa. It appears that East Asia was able to experience a miracle of structural change leading to industrialization because its industrial strategies were based on the valorization of its comparative advantage. Trade openness has thus allowed it to progressively move up the value chain. From being an exporter of agricultural raw materials, this region of the world has emerged as one of the largest exporters of labor-intensive manufacturing products. Today, some East Asian countries are producers of high-tech manufacturing goods. In the case of sub-Saharan Africa, industrial policies were based on the development of capital-intensive industries while the region is abundantly endowed with cheaper labor with a scarcity of capital. This industrial strategy failed to industrialize Africa because of its unsustainability over time. Trade openness has resulted in the region's specialization in the export of mineral and agricultural commodities. Such a trade specialization, through the phenomenon of Dutch disease, has crowded out the African manufacturing sector. Empirically, I analyze the impact of trade openness on a measure of inter-sectoral structural transformation between the agriculture sector and the manufacturing sector. Dynamic macro-econometric models, namely pool mean group and dynamics ordinary least squares have been applied. The objective is to avoid endogeneity in the trade openness measure. The results show that the long term evolution of trade openness negatively impacts the long-run and the short-run dynamics of structural change. Moreover, this impact goes through aggregate exports not aggregate imports. By breaking down global exports, we find that commodities exports have a negative impact while manufacturing exports positively impact structural change. These results are explained by the fact that, contrary to Asian countries, African countries have failed to put trade at the service of industrialization by following the logic of comparative advantage. More precisely, they have failed to invest the revenues from commodities exports to improve the quality of infrastructure in order to remove the constraints on the relocation to labor-intensive manufacturing activities. Chapter 6 focuses on the issue of South-South trade. Indeed, North-Africa trade has been characterized by a kind of duality. On the one hand, the former is specialized in manufacturing exports and on the other hand, the latter is specialized in natural resource exports. Some authors have therefore argued that South-South trade should lead to greater diversification of exports. Their rationale was that, given the small development gap between developing economies, South-South trade would allow for a more equitable trade gain. The present Chapter explores this hypothesis and conducts a comparative study between the effects of Africa-China and China-other developing countries (ODCs) trade on industrialization in both regions. I find that there is a clear difference between the impact of Africa-China and ODC-China trade. The results show that trade with China is a source of deindustrialization in Africa on the aggregate exports side while it is a source of industrialization for ODC on the exports side. In the case of Africa, the underlying mechanism of aggregate exports' impact is through heavy dependence on commodities exports to China while, for ODC, it is through manufacturing exports to China. Moreover, imports from China to Africa and ODC are a source of deindustrialization. Thus, the hypothesis of export diversification through South-South trade holds for ODC but not for Africa. Therefore, based on the South-South trade theory, the results indicate that Africa is a special case compared to ODC. Given that trade with China is a source of deindustrialization in Africa, the question is how Africa can take advantage of this trade to industrialize.

7.2 Policy recommendations and avenues for future research

7.2.1 Policy recommendations

The issue of improving the quality of electricity service must be a top priority for African policymakers. Indeed, undervaluation can be a double-edged sword for some companies as it can discourage them from making innovation and self-generation efforts. Moreover, undervaluation is a short-term solution because of the exchange rate competition that it could fuel. Regarding its difficulty to be maintained in the long term, it can be substituted by policies improving the quality of electricity service, which is a more sustainable solution for firms' performance. In addition, African governments must reduce the transaction costs that labor-intensive industries face by building good infrastructure and business environment. Thus, countries from this region will be able to produce and export labor-intensive manufacturing goods as East Asian countries have done. Two strategies according to two groups of countries can be undertaken to improve electricity infrastructure. Given the hydroelectricity capacity of some countries in sub-Saharan Africa, regional and sub-regional cooperation should be organized around the construction of hydroelectric dams that can power several countries at once. Such a cooperation can be used to raise funds on the financial markets. Another category of countries has a strong potential in the production of solar energy. This comparative advantage should be mobilized to diversify energy sources to reduce overloading of the traditional electricity supply networks. High-potential solar power plants can be built for industrial zones to prevent firms from production losses due to power outages and thus layoffs of workers. Second, as a short-term measure, states should subsidize the costs associated with the use of generators by businesses. This will reduce or eliminate the high transaction costs that affect the employment capacity of firms and their willingness to lay off employees. To improve their sales and benefit from the spending effect of remittances, African manufacturing firms need to enhance the competitiveness of their products. Policymakers can also play a key role in improving the quality of local products by ensuring adequate transport and energy infrastructure. Policymakers can also help promote local products, especially those produced by small firms, by subsidizing them. Africa could have both advantage in its imports and exports with China. On the import side, African governments must put in place trade policies aimed at reducing the cost of importing intermediate inputs and physical capital from China. For instance, policy makers can target inputs on which industrial production depends heavily and reduce their tariffs. This will reduce the costs of investment in manufacturing firms by reducing the investment's cost associated to these inputs. Consequently, the economic costs of the infrastructure deficit in these countries will be reduced. On the exports side, African governments have two possibilities which seem to be alternative. First, wage rate is increasing in China so governments could attract Chinese firms to locally process commodities imported by China from African countries. However, in some economies of this continent, the quality of infrastructure and institutions generates production losses in industrial firms. Thus, African governments should provide incentives such as special economic zones in which all the conditions for manufacturing activities are required. Second, as is already the case in some African countries, governments can sell raw materials in exchange for the construction of road and power infrastructure by Chinese firms, which will ultimately reduce the economic cost of investment in the industrial sector. However, this type of exchange can be fraught with institutional problems, so it is critical to have institutional guarantees of contract compliance.

7.2.2 Avenues for future research

Despite the crucial role of industrialization in the development of nations, Africa is struggling to achieve industrial take-off. Although this thesis highlights the critical determinants of Africa's industrialization, the geopolitical and trade changes that the world is undergoing are renewing the role of industrialization for Africa. There are many questions regarding how Africa's industrialization could be vulnerable to or be enhanced by global value chains, the relationship between emerging and developed countries, the war in Ukraine, and other geopolitical and trade changes. This thesis thus opens up a debate on the magnitude and empirical effect that the current geopolitics may have on industrial firms in Africa.

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