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Three Essays on Poverty and Well-Being in Developing Countries

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Résumé

Les différents travaux développés dans cette Thèse visent à fournir une meilleure compréhension des déterminants de la pauvreté et du bien-être dans les pays en développement. Ce faisant, ils permettent de suggérer plusieurs pistes permettant d'atteindre les deux premiers objectifs du Programme de Développement Durable à l'horizon 2030 élaboré par les Nations Unies. En partant de données macroéconomiques, et en approfondissant notre analyse à l'aide de données au niveau des ménages, cette Thèse explore les types de privations sociales qui caractérisent la pauvreté, ainsi que les principaux facteurs influençant certaines de ces privations telles que la santé nutritionnelle des enfants. La Thèse débute par une étude macroéconomique couvrant 64 pays en développement, se poursuit par une analyse reposant sur des données d'enquête relatives au Guatemala, et se termine par une évaluation de l'impact d'un programme de santé mis en œuvre par la Fondation FUNDAP dans les régions occidentales du même pays en utilisant des données individuelles plus spécifiques. Plus précisément, le premier Chapitre analyse la relation entre aide au développement et réduction de la pauvreté, un sujet sur lequel les études existantes n'ont pas débouché jusqu'à présent sur des résultats tranchés. Le Chapitre 2 vise à comprendre et à évaluer dans quelle mesure le développement de la production d'huile de palme au Guatemala (secteur agro-exportateur) contribue à accroître l'insécurité alimentaire, mesurée ici par une plus forte dénutrition observée chez les enfants. La dernière étude développée dans le troisième et dernier Chapitre cherche à évaluer les incidences de la mise en place d'un programme nutritionnel dans l'Ouest du Guatemala, appelé "Volontaires en Santé", qui opère au niveau des communautés et vise à renforcer les capacités des individus (90% de femmes) en leur donnant une formation ciblée sur la nutrition des enfants et les soins médicaux de base.

Abstract

The research developed in this Thesis seeks to provide greater understanding on the determinants of poverty and well-being in developing countries and, by doing so, to highlight several paths to achieve the two first Sustainable Development Goals of the Agenda 2030. Starting with national data, to deepen the analysis using individual and household level data, this Thesis explores the types of social deprivations that characterize poverty and the factors that have a significant impact on some of them such as the nutritional health of children. It begins with a macroeconomic analysis for 64 developing economies, to continue with an analysis based on survey data for Guatemala, and finalizes with an impact evaluation using more specific individual data from a health program implemented by the Foundation FUNDAP in the western regions of the same country. More precisely, Chapter 1 analyzes the relationship between development aid and poverty reduction, a topic for which previous studies have not yet produced conclusive results. Chapter 2 aims to understand and evaluate to what extent the expansion of african palm crop in Guatemala (agro-export sector) contributes to increasing food insecurity, as measured by higher child undernutrition. The last study presented in Chapter 3, seeks to evaluate the impact of a nutritional intervention in West Guatemala, called

"Volunteers in Health", which operates at the community level and builds capacity by training individuals (90% women) on issues related to child nutrition and basic nursing.

Introduction Générale

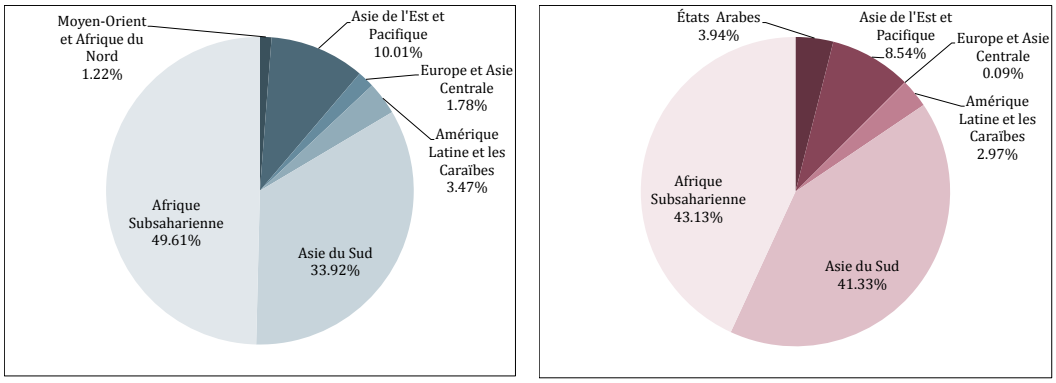
En septembre 2015, les États membres des Nations Unies ont adopté le Programme de développement durable à l'horizon 2030. Ce programme comprend dix-sept Objectifs de Développement Durable (ODD) qui doivent permettre de guider les pays dans la réalisation d'un 'développement durable, inclusif et respectueux de l'environnement' (United Nations, 2018). Depuis l'adoption de ces objectifs, les pays ont commencé à les intégrer dans leurs plans nationaux et à élaborer des politiques et des stratégies en conséquence. Cependant, quatre ans après le lancement du Programme 2030, le premier Rapport Mondial sur le Développement Durable (GSDR en anglais) suggère que des améliorations doivent encore être apportées dans la mise en place de ces objectifs, via notamment une meilleure prise en compte des liens existant entre tous ces objectifs, afin d'accélérer les progrès vers leur réalisation. En particulier, ce rapport identifie six principales pistes, dont la première vise à améliorer les capacités des individus jugées nécessaires pour atteindre le premier et le plus ambitieux objectif de développement durable consistant à 'éliminer la pauvreté sous toutes ses formes, partout dans le monde' (United Nations, 2019) .

En effet, bien que le niveau de vie des individus se soit amélioré au cours des dernières décennies, des privations importantes persistent et les progrès réalisés ont été inégalement distribués dans le monde (United Nations, 2019). La pauvreté monétaire dans les pays en développement, mesurée par le pourcentage de la population vivant avec moins de $1.90 par jour, touchait 11.2% de la population de ces pays en 2013, soit environ 800 millions de personnes dans le monde. FootnoteCalcul effectué à l'aide de la base de données World Development Indicators.. La répartition de ce taux de pauvreté dans le monde se caractérisait par une concentration géographique marquée. Ainsi, environ 80% des individus touchés par cette pauvreté monétaire vivaient en Afrique Subsaharienne et en Asie du Sud (figure 0.0.1).

Cependant, la pauvreté ne mesure pas seulement l'insuffisance de revenus pour satisfaire les besoins essentiels des individus (United Nations, 2018). Elle peut également se manifester via des privations élémentaires en matière d'éducation, de nourriture, de logement et/ou de santé (Wang et al., 2016). Lorsque la pauvreté est mesurée à l'aide de l'indice de pauvreté multidimensionnelle (IPM) qui tient compte de ces multiples privations et de leurs interactions, elle concerne 23.1%

Figure 0.0.1 – Répartition du taux de pauvreté monétaire et multidimensionnelle par région

Pauvreté Monétaire **Pauvreté Multidimensionnelle**



Source: Oxford Poverty and Human Development Initiative et World Development Indicators.

d'individus dans le monde en 2019 – 1.3 milliard de personnes dans 101 pays en développement – (OPHI, 2019). La répartition spatiale de cette pauvreté est également inégale, avec également plus de 80% d'individus touchés par cette pauvreté multidimensionnelle vivant en Afrique Subsaharienne et en Asie du Sud (figure 0.0.1).

Lorsque l'on compare la diminution des taux de pauvreté par région (figure 0.0.2), on constate que la région Asie de l'Est et Pacifique ainsi que l'Afrique Subsaharienne ont réalisé des progrès plus importants en matière de réduction de la pauvreté monétaire. En effet, la part de la population vivant avec plus de \$1.90/jour a augmenté entre 2010/11 et 2014/15. Cette amélioration a été plus importante que celle constatée au niveau de la pauvreté multidimensionnelle. À l'inverse, la région Amérique Latine et Caraïbes est la région où la baisse de la pauvreté multidimensionnelle entre 2008/09 et 2012/13 a été plus importante que celle de la pauvreté monétaire. En revanche, en Asie du Sud, les deux types de pauvreté ont diminué. Le graphique 0.0.2 montre également que, même si des progrès ont été accomplis, la part des individus touchés par la pauvreté multidimensionnelle reste supérieure à celle des individus souffrant de pauvreté monétaire dans les quatre régions considérées. Ceci suggère que, même si une part importante de la population semble vivre au-dessus du seuil de pauvreté monétaire, elle peut cependant continuer à subir des privations élémentaires qui peuvent par ailleurs se cumuler (logement insalubre, manque d'éducation, santé et nutrition médiocres et accès à des sources insalubres d'eau, par exemple).

Les deux mesures de pauvreté renvoient en réalité à des visions différentes du bien-être des individus et identifient donc la pauvreté différemment. Alors que le montant de \$1.90 par jour considère

les aspects monétaires de la pauvreté, l'indice de pauvreté multidimensionnelle met plutôt l'accent sur ses aspects non monétaires. Par conséquent, les deux mesures se complètent et constituent ainsi des instruments pertinents pour suivre les progrès accomplis dans la réalisation du premier ODD (United Nations, 2019).

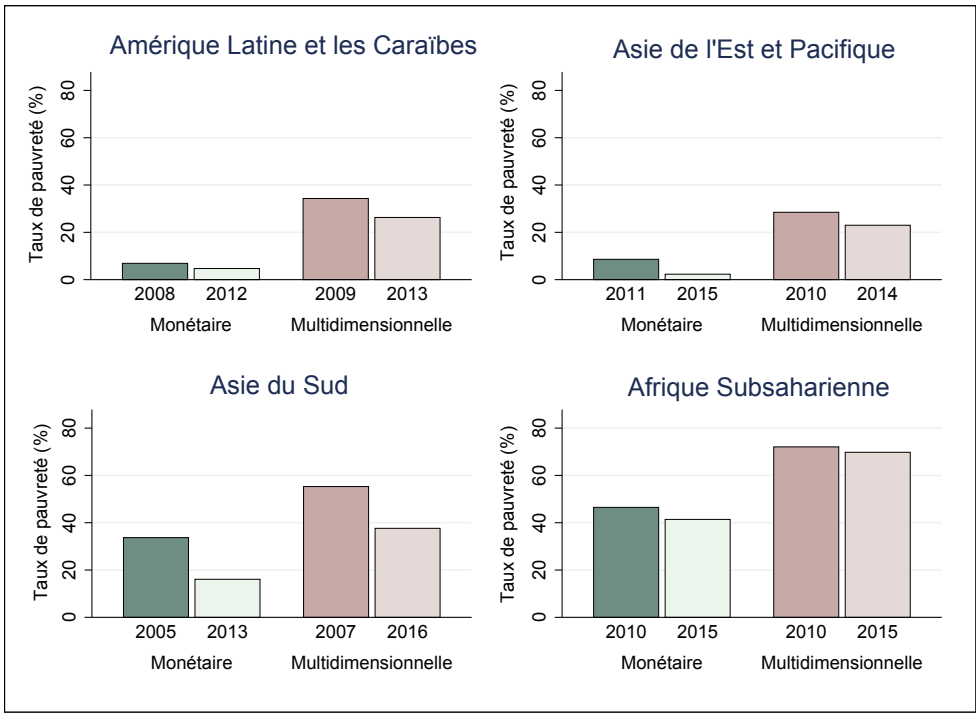
L'un des leviers suggéré par le GSDR consiste à améliorer la politique économique et les financements. En particulier, encourager l'aide officielle au développement (ODA) dans les secteurs et activités contribuant au bien-être humain reste essentiel dans de nombreux pays en développement (United Nations, 2019).

Le montant des aides officiels au développement reçu par les pays en développement a augmenté depuis la première vague de financements survenue en 1960. Elle a été suivie de trois vagues successives – entre les années 1960 et le début des années 1970; entre 1972 et la fin des années 1990 et à partir des années 2000 – et a atteint un montant total de $160.8 milliards en 2017 (figure 0.0.3). Cet accroissement de l'aide au développement a été inégalement réparti entre les régions du monde. L'Asie du Sud, l'Afrique Subsaharienne, la région du Moyen-Orient et de l'Afrique du Nord, ainsi que l'Asie de l'Est et le Pacifique ont reçu les parts les plus importantes au cours des deux premières vagues de financements. En revanche, l'Europe et l'Asie Centrale ainsi que d'autres pays ont vu leur part augmenter au cours des deux dernières décennies. L'Afrique Subsaharienne était en 2017 la région qui recevait la plus grande part des flux d'aide au développement, suivie par la région du Moyen-Orient et l'Afrique du Nord (figure 0.0.3).

Cependant, malgré les montants énormes d'aide au développement reçus par les pays en développement, les graphiques 0.0.1 et 0.0.2 montrent qu'une partie importante de la population de ces pays (11,2%) ne dispose toujours pas de revenus suffisants pour couvrir les dépenses en besoins essentiels et que 23.1% de cette population est toujours confrontée à une pauvreté multidimensionnelle. Aussi, une première interrogation à laquelle cette Thèse vise à apporter des éléments de réponse est de savoir si les flux d'aide au développement peuvent contribuer à réduire les différents types de pauvreté.

En analysant plus précisément la composition de l'indice composite de pauvreté multidimensionnelle, le premier indicateur qui préside à sa définition identifie si un individu vivant dans un ménage composé d'au moins une personne de moins de 70 ans (pour lequel des informations nutritionnelles sont disponibles) est sous-alimenté (OPHI, 2018). Sur les 1.3 milliard de personnes identifiées comme souffrant de pauvreté multidimensionnelle en 2019 dans 101 pays en développement, 27% vivant dans des ménages où au moins une personne de moins de 70 ans souffrent de sous-alimentation. Le graphique 0.0.4 montre ces individus vivent majoritairement en Afrique Subsaharienne et en Asie du Sud.

Figure 0.0.2 – Évolution des taux de pauvreté monétaire et multidimensionnelle par région



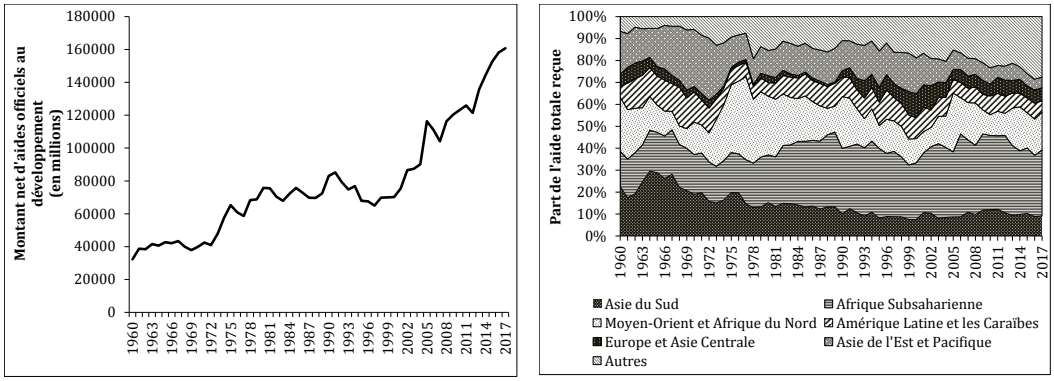
Source: World Development Indicators et Oxford Poverty and Human Development Initiative.
Remarque: pour la pauvreté multidimensionnelle, la région de l'Asie de l'Est et du Pacifique est représentée par le Cambodge et le Viet Nam; la région Amérique Latine et Caraïbes est représentée par Haïti et le Pérou; la région pour l'Asie du Sud est représentée par le Bangladesh, l'Inde et le Pakistan; et la région de l'Afrique Subsaharienne est représentée par la République Démocratique du Congo, l'Éthiopie et le Nigéria. Vous trouverez plus d'informations sur la sélection des pays dans: Alkire et al. (2019).

Ce chiffre est d'autant plus important qu'une autre piste identifiée par le Rapport Mondial sur le Développement Durable consiste à améliorer les systèmes alimentaires et les schémas nutritionnels mondiaux, de manière à atteindre le deuxième objectif de développement durable 'Mettre fin à la faim, atteindre la sécurité alimentaire, améliorer la nutrition et promouvoir une agriculture durable' (United Nations, 2019).

En effet, le système alimentaire mondial renvoie aux liens qu'entretiennent entre eux la production alimentaire, les activités liées à l'alimentation, la disponibilité des ressources naturelles, et les processus avec lesquels les aliments sont produits (United Nations, 2019). Or, les études s'accordent pour souligner que des milliards d'hectares de terres ont été dégradés, que de mauvaises pratiques

Figure 0.0.3 – Montant net d'aides officiels au développement reçus

Total dans le monde entier **Part par région**

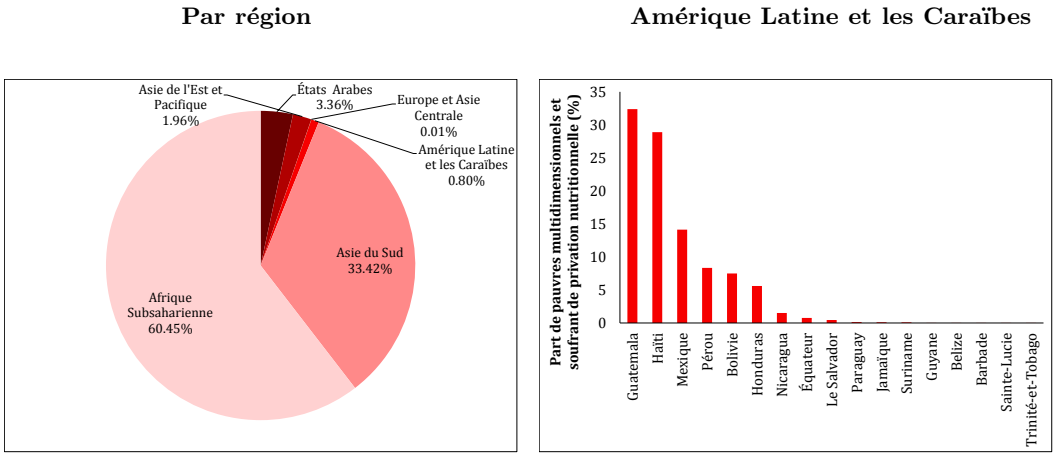


Source: World Development Indicators.
Remarque: Montant net d'aides officiels au développement en US$ constants de 2016.

agricoles ont entraîné une pollution de l'eau, une dégradation des sols et de l'environnement. La concentration de la production alimentaire s'accentue, ce qui fragilise la résilience du système alimentaire mondial et l'offre d'aliments adaptés à la population mondiale. Les personnes vivant dans les zones rurales ont de plus en plus de difficultés à vivre de leurs terres agricoles et sont contraintes de migrer vers les zones urbaines, à la recherche d'opportunités d'emplois leur permettant de compléter le revenu familial (United Nations, 2018). Aujourd'hui, environ 2 milliards de personnes dans le monde connaissent un certain niveau d'insécurité alimentaire et n'ont pas accès à une nourriture comprenant une quantité suffisante de calories. Ces personnes risquent donc de souffrir de diverses formes de dénutrition et les populations les plus vulnérables, les femmes et les enfants, sont celles qui sont les plus touchées par ce phénomène (FAO, 2019).

Ainsi, selon la Banque Mondiale, 10.8% des enfants de moins de cinq ans dans le monde étaient sous-alimentés en 2017, ce phénomène se concrétisant notamment par un retard de croissance de 22.2% et d'émaciation de 7.5%. Près de deux enfants sur cinq présentant un retard de croissance vivent en Asie du Sud, tandis qu'un sur trois vit en Afrique Subsaharienne. En Amérique Latine et dans les Caraïbes, les pourcentages d'enfants présentant un retard de croissance sont très inférieurs à ceux de l'Asie du Sud et de l'Afrique Subsaharienne – 9.6% en moyenne, contre 35% et 34%, respectivement (UNICEF and WHO and World Bank, 2018) –, avec une exception cependant constituée par: le Guatemala. Selon MSPAS and INE and Segeplán (2017), 46.5% des enfants de moins de cinq ans présentaient un retard de croissance et 12.6% souffraient d'insuffisance pondérale en 2014/15. Le graphique 0.0.4 montre que sur le nombre total de personnes confrontées à la pau-

Figure 0.0.4 – Part de la population confrontée à la pauvreté multidimensionnelle et soufrant de privation nutritionnelle



Source: Oxford Poverty and Human Development Initiative.

vreté multidimensionnelle et soufrant de privation nutritionnelle dans la région Amérique Latine et Caraïbes en 2019, la plus grande part (32.4%) vit au Guatemala.

Le Guatemala est le pays le plus peuplé d'Amérique Centrale avec près de 17 millions d'habitants en 2017, dont 50.5% vivent dans les zones rurales (INE, 2014). Ce pays est divisé administrativement en huit régions et vingt-deux départements. Il se caractérise par une biodiversité importante, comprenant quatorze écorégions avec cinq écosystèmes différents. La diversité ethnique, culturelle, raciale et linguistique est une autre caractéristique de ce pays. Selon la dernière Enquête Nationale sur la Santé de la Mère et des Enfants (ENSMI) de 2014/2015, environ 44.4% des mères étaient d'origine autochtone, d'ascendance amérindienne, correspondant au pourcentage le plus important en Amérique Latine, après le Pérou et la Bolivie. La plupart des Guatémaltèques autochtones descendent des Mayas. Bien que l'espagnol soit la langue officielle, il existe au moins vingt-quatre langues maya, chacune appartenant à un groupe ethnique: les K'iche' (11.0% de la population totale), les Q'eqchi (8.3%), les Kaqchikel (7.8%). %), les Mam (5.2%) et "autres Maya" (7.6%). Moins de 1% de la population ne descend pas des mayas (MSPAS and INE and Segeplán, 2017).

Le pays est classé dans la catégorie des pays à bas revenu intermédiaire et son revenu national brut par habitant était de $US 3,104 en 2018 [1] (World Bank, 2017). Pourtant, il se caractérise également par un des plus faibles indices de développement humain en Amérique Latine, après Haïti

[1] PPA constante 2010.

et le Honduras: 0,650 pour 2017.[2] La pauvreté et les inégalités sont des phénomènes chroniques et leurs taux sont parmi les plus élevés de la région d'Amérique Latine et des Caraïbes: les dernières données disponibles pour 2014 indiquent que le niveau d'inégalité, mesuré par l'indice de Gini, était de 48.3[3]; la proportion de la population identifiée comme souffrant de pauvreté multidimensionnelle était de 28.9% en 2014, soit le deuxième taux le plus élevé d'Amérique Latine après Haïti; la part de la population vivant en dessous du seuil de $1.90 par jour était de 8.7%[4], et concerne principalement la population autochtone et rurale (Rios and Berania, 2015).

Un des problèmes les plus importants auxquels est confronté le Guatemala est la concentration de la propriété des terres, qui se traduit par une réduction des terres disponibles pour les cultures. L'indice de Gini relatif à la concentration de la propriété de la terre est le deuxième le plus élevé d'Amérique Latine et atteignait, selon le dernier recensement agricole national de 2003, 0.84: 92.1% des petits producteurs cultivent 21.9% de la superficie agricole avec une moyenne de 2 hectares par propriété, alors que 1.9% des producteurs commerciaux cultivent 56.6% des terres agricoles, avec une moyenne de 137 hectares par propriété (INE, 2004). Ce problème de concentration n'est pas récent et s'est traduit par des guerres civiles et des conflits agraires entre 1960 et 1996, la mort de 200.000 personnes, le massacre de communautés autochtones entières et le déplacement de plus d'un million de personnes (CEH, 1999, REMHI, 1999, Solomon and Bailis, 2013). Ces conflits sont apparus après le coup d'État militaire (soutenu par la CIA) qui a eu lieu en 1954 contre le président Jacobo Arbenz et la réforme agraire qu'il avait tenté de mettre en œuvre afin de redistribuer les terres agricoles en faveur de la population la plus défavorisée du Sud du Guatemala (CEH, 1999).

Le secteur agricole a été le principal moteur de la croissance économique au cours des dix dernières années (Sanchez et al., 2016). Il est marqué par une forte dualité, avec d'un côté un secteur exportateur relativement récent reposant essentiellement sur la culture de canne à sucre, d'huile de palme, de café, de cardamome et de bananes (United Nations, 2017), et de l'autre, un secteur plus traditionnel, moins productif mais beaucoup plus vital pour les familles autochtones et paysannes, et reposant sur la production de maïs et de haricots, principalement. En effet, l'alimentation de base au Guatemala est composée principalement de tortillas de maïs, et d'haricots secs. Le Ministère de l'Agriculture du Guatemala (MAGA) estime que près de 0,8 million de ménages sont de petits producteurs issus de d'une agriculture de subsistance et faisant l'objet d'échanges locaux, cultivant essentiellement du maïs et des haricots sur près d'un tiers de la superficie agricole cultivée au Guatemala (Sanchez et al., 2016).

Cependant, alors que les cultures agricoles commerciales telles que l'huile de palme et le sucre

[2]Données disponibles sur http://hdr.undp.org

[3]L'indice de Gini se situe entre 0, égalité parfaite, et 100, inégalité parfaite. Informations complémentaires disponibles sur le site PovcalNet de la Banque Mondiale.

[4]Données tirées des derniers tableaux disponibles sur le Indice de Pauvreté Multidimensionnelle (IPM) Mondial 2019 dans le site web https://ophi.org.uk/.

ont vu leurs rendements augmenter pour atteindre des niveaux compétitifs, les rendements des cultures de base, produits pour une grande partie par des agriculteurs pauvres, stagnent. Cette situation a entraîné une forte dépendance du pays aux importations de maïs depuis les années 2000 (provenant principalement des États-Unis), le maïs devenant l'un des huit principaux produits importés en 2015 (United Nations, 2017). Dans le même temps, la production d'huile de palme au Guatemala a fortement augmenté depuis les années 1980 et est devenue le nouveau moteur de la production agricole. La croissance du nombre d'hectares cultivés atteint 17.3% par an depuis 2003 (CABI, 2017).

L'expansion de la production d'huile de palme s'est tout d'abord effectuée au détriment des plantations de coton et des terres utilisées pour l'élevage du bétail dans la région du Sud-Ouest du Guatemala. Plus récemment, son expansion a donné lieu à un dragage illégal de rivières, à une utilisation abusive des ressources en eau, à l'achat et la dépossession forcée des terres détenues par la population indigène. Cette situation représente non seulement une déstructuration des modes de vie établis au sein des familles et des communautés autochtones, mais elle compromet également leur accès à une nourriture suffisante et augmente les risques de malnutrition notamment pour la population la plus vulnérable, composée des enfants et des femmes (Castro et al., 2015).

Compte tenu de de contexte et de l'objectif de développement durable visant à "éliminer la faim, assurer la sécurité alimentaire, améliorer la nutrition et promouvoir une agriculture durable", cette Thèse vise également à apporter des éléments de réponse à l'interrogation suivante: les modalités avec lesquelles le secteur agricole exportateur se développe au Guatemala, affectent-elles la santé nutritionnelle de la population la plus vulnérable?

Un levier important identifié par le GSDR qui pourrait faciliter la réalisation des Objectifs de Développement Durable, et qui pourrait être également un puissant vecteur d'amélioration des comportements nutritionnels des populations les plus marginalisées au Guatemala, est de renforcer les actions individuelles et collectives. En particulier, promouvoir l'autonomisation des femmes et renforcer leurs capacités par le biais de politiques et de programmes sociaux leur permettant d'être les actrices de leur propre vie ainsi que celle de leurs communautés, sont considérés comme des instruments essentiels pour atteindre les obejectifs du développement durable (United Nations, 2019).

En effet, de nombreuses études analysant la relation entre les connaissances acquises par la mère et l'état de santé des enfants dans les pays en développement montrent combien il est essentiel et pertinent d'accroître l'éducation générale des femmes pour améliorer la santé des enfants. Par exemple, Glewwe (1999) a constaté qu'au Maroc la scolarisation joue un rôle fondamental dans l'éducation des mères de famille en leur permettant, de manière indirecte, d'acquérir des connaissances en matière de santé, et finalement de mieux prendre soin de la santé de leurs enfants. Chou

et al. (2010) ont évalué les effets de l'ouverture de plus de 150 nouvelles écoles élémentaires à Taïwan en 1968, et visant à prolonger l'enseignement obligatoire de 6 à 9 années. Ils ont constaté que le prolongement de la scolarité des mères se traduit par une amélioration de la santé des enfants. Ainsi, une augmentation de la scolarité réduit la probabilité qu'un enfant naisse avec une insuffisance pondérale ou meure au cours de la période néonatale ou post-néonatale. Une autre étude réalisée dans l'Inde rurale par Imai et al. (2014) révèle que l'augmentation de l'éducation des mères par rapport à celle des pères est associée à un meilleur état nutritionnel des enfants.

Une étude menée par Fitzsimons et al. (2016) dans les zones rurales du Malawi montre comment la mise en œuvre d'un programme de santé visant à fournir aux mères des informations sur la nutrition des enfants contribue à une meilleure croissance physique de ces derniers. Le programme consistait à former les femmes à une échelle locale. Celles-ci rendaient visite aux mères avant et après la naissance de l'enfant et leur fournissaient également des informations sur l'alimentation du nourrisson. A partir de données collectées sur le terrain, les auteurs mettent en évidence une amélioration du régime alimentaire des enfants et de la consommation alimentaire des ménages, notamment grâce à l'augmentation du nombre de repas riches en protéines, en fruits et en légumes.

Depuis 2001, un programme similaire est mis en œuvre par la Fondation FUNDAP dans les régions du Nord-Ouest et du Sud-Ouest du Guatemala. Le programme, appelé "Volontaires en Santé", fonctionne au niveau communautaire et forme des individus (90% des femmes) sur des questions liées à la nutrition de l'enfant et aux soins de santé de base. Une fois que les "volontaires" ont terminé leur formation, ils commencent à offrir un service aux mères et aux enfants, intitulé "cycles de récupération nutritionnelle", qui consiste à améliorer les connaissances des mères en matière de pratiques alimentaires et de santé de l'enfant, à leur fournir des aliments et des vitamines pour les enfants, et à mesurer la croissance des enfants pendant six mois. En ce sens, les volontaires apportent un soutien aux mères pendant les premières années de vie de l'enfant, devenant généralement la personne de référence la plus proche pour les aider à élever leurs enfants. L'acquisition de ces connaissances spécifiques et la possibilité de les transmettre aux mères se traduit par une meilleure autonomisation des femmes dans cette région vulnérable, où l'ignorance concernant la fertilité, les méthodes de contrôle des naissances, l'hygiène et la nutrition est encore élevée.

En nous appuyant sur le travail réalisé par l'équipe de la Fondation FUNDAP et les Volontaires en Santé afin de réduire la malnutrition infantile dans l'Ouest du Guatemala, nous cherchons à évaluer sa pertinence eu égard à la réalisation du deuxième Objectif de Développement Durable. Aussi la troisième question de recherche à laquelle nous entendons répondre dans cette Thèse est la suivante: l'augmentation de l'éducation des femmes et des connaissances des mères contribue-elle à améliorer la santé nutritionnelle des enfants dans l'Ouest du Guatemala?

En cherchant à répondre aux trois questions principales soulevées précédemment, cette Thèse vise ainsi à fournir une meilleure compréhension des déterminants de la pauvreté et du bien-être dans les pays en développement. En partant d'une analyse macroéconomique dans un premier temps et en situant nos recherches au niveau des ménages par la suite, cette Thèse cherche à analyser les différents types de pauvreté auxquels sont confrontés les pays en développement, notamment en matière de privations sociales ainsi que les facteurs susceptibles de les atténuer. Pour ce faire, nos travaux débutent par une analyse macroéconomique effectuée sur 64 pays en développement, se prolongent avec une analyse reposant sur des données d'enquête portant sur le Guatemala et terminent par une évaluation effectuée à partir de données individuelles plus spécifiques découlant d'un programme de santé mis en œuvre par la Fondation FUNDAP dans une des régions du même pays.

Plus précisément, la Thèse se structure autour des trois chapitres suivants:

- **Chapter 1: Does Aid reduce Poverty?**

La question de savoir si l'aide au développement contribue à réduire la pauvreté dans les pays bénéficiaires de cette aide a fait l'objet de nombreux travaux macroéconomiques, depuis plus de cinquante ans sans que ceux-ci parviennent à des résultats concluants (Clemens et al., 2004, McGillivray et al., 2006, White, 1992). Le manque de données fiables sur la pauvreté et les difficultés rencontrées sur le traitement du lien de causalité entre aide et pauvreté constituent notamment les principaux défis posés par le traitement de cette question. Ce premier chapitre analyse la vaste littérature disponible sur le sujet et cherche à combler ces deux principaux écueils.

Pour ce faire, j'utilise tout d'abord des données nouvelles et originales concernant la pauvreté multidimensionnelle. Ces données sont fournies par le centre de recherche Oxford Poverty and Human Development Initiative (OPHI) de l'Université d'Oxford[5], et incluent des informations détaillées sur les différentes privations sociales auxquelles peuvent être confrontées les personnes pauvres. Il m'est ainsi possible d'analyser la relation directe entre l'aide au développement et la pauvreté – au lieu d'utiliser la croissance économique comme indicateur indirect de la réduction de la pauvreté, comme le faisait la littérature précédente – et, par conséquent, de prendre en compte d'autres facteurs – autres que le revenu – susceptibles d'affecter le bien-être des individus dans le monde, comme l'éducation, la santé et la qualité de vie (World Bank, 1998).

De plus, pour répondre au second écueil, j'utilise le nombre d'années durant lesquelles les pays ont été membres temporaires du Conseil de Sécurité des Nations Unies (UNSC) comme variable instrumentale du montant moyen de l'aide économique versée par les États-Unis. En effet, les États-Unis ont commencé à fournir de l'aide aux pays en développement en 1946, lors de la création

[5]Centre de recherche du Département du Développement International d'Oxford (ODID) au sein de l'Université d'Oxford: https://ophi.org.uk/

du Conseil de Sécurité et à une période où l'aide était conçue comme le moyen par lequel les pays en développement pouvaient renforcer leur croissance économique. Des études suggèrent cependant que le montant de l'aide versée par les États-Unis entre 1946 et 1999 était plutôt motivé par des motifs politiques et diplomatiques, et n'était donc pas lié nécessairement à des motifs de développement (Kuziemko and Werker, 2006, Meernik et al., 1998).

En utilisant un échantillon de 64 pays en développement, je trouve que des montants d'aide plus importants reçus entre 1946 et 1999 se traduisent par un Indice de Pauvreté Multidimensionnel (IPM) plus faible entre 2000 et 2014. Cette relation est cependant non significative lorsque la pauvreté est mesurée d'un point de vue monétaire. Ces résultats sont robustes à l'utilisation de spécifications alternatives et à des tests de sensibilité différents. Ils suggèrent que le recours à des mesures alternatives de pauvreté pourrait permettre d'améliorer la compréhension de la relation entre l'aide au développement et la réduction de la pauvreté, et contribuer à une meilleure appréhension des effets de l'aide au développement selon les différentes formes de privations sociales. En ce sens, ces résultats fournissent des éléments permettant un meilleur ciblage de l'aide au développement.

- **Chapter 2: The Impact of the Expansion of African Palm Crop on Child Undernutrition in South-West Guatemala**

Le Chapitre 2 examine dans quelle mesure le développement de la culture de l'huile de palme dans la région du Sud-Ouest du Guatemala affecte la sécurité alimentaire et nutritionnelle de la population la plus vulnérable, mesurée ici par une augmentation de la probabilité que des enfants soient sous-alimentés. Castro et al. (2015) et Hurtado (2008) expliquent comment l'expansion de cette monoculture depuis 2010 préempte des terres agricoles familiales et communales ainsi que des ressources en eau, essentielles à la production d'aliments destinés à la consommation personnelle des familles autochtones et à leur vente sur les marchés intérieurs. L'exploitation d'huile de palme touche également d'autres familles de paysans sans terre qui louaient une partie de ces terres pour la production de céréales de base, et qui sont forcés d'émigrer et de se réinstaller de manière plus précaire ailleurs.

La plupart du temps, les hommes – mais aussi les femmes et les enfants – sont employés dans des exploitations d'huile de palme, où les conditions de travail demuerent précaires. Ceci se traduit par une augmentation et un allongement du temps de travail quotidien des femmes, qui peuvent être contraintes de migrer vers les zones urbaines à la recherche d'emplois additionnels leur permettant de compléter le revenu familial Castro et al. (2015). Castro et al. (2015) fait également état de la pollution des rivières causée par le rejet des eaux usées dans des plantations, qui ont souvent recours à l'utilisation en grande quantité d'engrais et de pesticides. Cette pratique met non seulement en péril la biodiversité régionale, en réduisant la population des poissons et en provoquant des inondations sur les terres agricoles pendant la saison des pluies, mais elle expose également la

population des zones urbaines et rurales à des substances nocives pour leur santé.

L'impact de ces pratiques, ainsi que de celles menées par l'industrie de la canne à sucre, sur l'accès à la terre, les conditions de travail, la mauvaise utilisation des ressources en eau et le déplacement forcé de communautés autochtones au Guatemala, a déjà été décrit dans Tomei (2015) et Alonso-Fradejas et al. (2008). Dans les régions d'Amérique Latine et des Caraïbes, Ávila-Romero and Albuquerque (2018) et Sabogal (2013) étudient l'expansion de la culture d'huile de palme au Brésil, au Mexique et en Colombie, qui suit des modalités similaires à celles du Guatemala, et montrent comment cette expansion accroît la dépendance économique vis-à-vis de la production de cultures agro-exportatrices – au détriment de cultures alimentaires destinées à la consommation locale – des communautés locales qui sont les plus affectées. Cependant, aucune étude n'a encore analysé l'impact de l'expansion de cette culture sur la sécurité alimentaire, en particulier sur la santé nutritionnelle des enfants, ce qui dans le contexte du Guatemala revêt une importance particulière.

L'analyse présentée dans le Chapitre 2 cherche à contribuer à la littérature en comblant cette lacune. En utilisant les données d'enquête de l'Enquête Nationale sur la Santé des Mères et des Enfants et une stratégie empirique reposant sur la méthode des doubles différences, mes résultats mettent en évidence une augmentation significative de la probabilité que les enfants de moins de cinq ans souffrent de malnutrition chronique lorsqu'ils vivent dans l'un des deux départements du Sud-Ouest du Guatemala – Quetzaltenango et San Marcos –, particulièrement touchés par l'expansion de l'huile de palme depuis 2010. Les enfants de mères autochtones vivant dans des zones urbaines et issus d'une cellule familiale où le chef de famille est un homme, sont ceux qui sont le plus touchés. Ces résultats sont robustes à différentes spécifications et à une autre méthode d'estimation. Ils suggèrent que l'amélioration du système alimentaire global du Guatemala, incluant une meilleure participation des activités agricoles paysannes indigènes, pourrait contribuer à éliminer la malnutrition, à améliorer la sécurité alimentaire et à promouvoir une agriculture plus durable favorisant une meilleure qualité de l'eau et ses sols.

- **Chapter 3: It Takes a Village to Raise a Child. Women's Education, Mother's Knowledge and Child Undernutrition in Indigenous Guatemala**

Afin de mieux comprendre les solutions possibles pouvant être apportées à la question de la malnutrition au Guatemala, le Chapitre 3 analyse l'impact d'un programme d'intervention sanitaire mis en place dans l'Ouest du pays et destiné aux enfants de moins de cinq ans. Cette étude est l'une des rares à avoir été réalisée sur ce sujet dans le contexte guatémaltèque. Marini and Gragnolati (2003) utilise des données d'enquête pour décrire les facteurs socioéconomiques, géographiques et ethniques qui caractérisent la malnutrition infantile dans le pays. Les auteurs constatent que les familles pauvres, rurales et autochtones, peu éduquées, sont celles où la malnutrition des enfants est la plus élevée. En guise de solutions possibles, ils suggèrent un renforcement des interventions en matière de nutrition, une amélioration dans l'accès aux services de soin élémentaires et

de l'éducation de la population guatémaltèque. L'étude réalisée par Maluccio et al. (2009) contribue à comprendre comment des actions favorisant la nutrition des enfants durant leurs premières années de vie influencent les performances économiques des adultes et montre comment la fourniture de suppléments nutritionnels aux enfants pourrait améliorer leurs capacités cognitives à long terme.

À l'aide d'informations originales portant sur des enfants de moins de cinq ans ayant participé aux cycles de récupération nutritionnelle mis en place par les Volontaires en Santé dans l'Ouest du Guatemala, le Chapitre 3 fournit de nouvelles preuves empiriques sur le rôle important joué par une meilleure éducation en matière de nutrition et par la fourniture de suppléments alimentaires dans l'amélioration de la santé des enfants. L'analyse développée dans ce chapitre est effectuée en deux étapes. Premièrement, elle se concentre sur l'évaluation de l'efficacité du programme entre 2015 et 2018, en mesurant l'évolution de la croissance des enfants pour chaque visite supplémentaire des volontaires au cours des six mois que dure l'intervention. Enfin, pour analyser l'impact positif exercé par ce programme, nous utilisons des informations supplémentaires fournies par une enquête nationale qui nous permet de construire un échantillon de contrôle constitué d'enfants n'ayant pas participé à ces cycles de récupération nutritionnelle. Notre analyse montre que la probabilité que les enfants souffrent d'insuffisance pondérale en 2015 a diminué de manière significative lorsque la croissance de ces enfants était surveillée par les volontaires et que les mères recevaient des informations sur la manière d'améliorer les pratiques nutritionnelles à l'égard de leurs enfants.

Ces résultats sont robustes à l'utilisation de spécifications alternatives et à un test de falsification. Ils suggèrent que l'intervention en matière de nutrition des enfants mise en œuvre par la Fondation FUNDAP dans les régions occidentales du Guatemala contribue de manière significative à la réduction de l'insuffisance pondérale chez les enfants de moins de cinq ans. Ils soulignent en quoi la mise en place de politiques au niveau local et impliquant la participation de tous les membres des communautés – et des femmes en particulier – peut être particulièrement efficace pour réduire la malnutrition infantile. Ce travail montre que l'éducation des femmes – vecteur d'autonomisation puissant – au niveau communautaire, pour permettre aux mères d'accéder à des informations sur la nutrition des enfants, ainsi que le suivi de la croissance des enfants et la fourniture de compléments alimentaires, représentent des instruments efficaces pour éliminer la malnutrition et pour ne "laisser personne de côté" dans l'Ouest du Guatemala.

A travers ces différentes analyses et les résultats présentés dans ce travail, cette Thèse espère suggérer plusieurs pistes possibles pour atteindre les deux premiers objectifs de l'Agenda 2030 ainsi que des actions sociales et politiques visant à améliorer le bien-être et les capacités humaines, afin que chaque individu dans le monde puisse vivre dans la dignité.

General Introduction

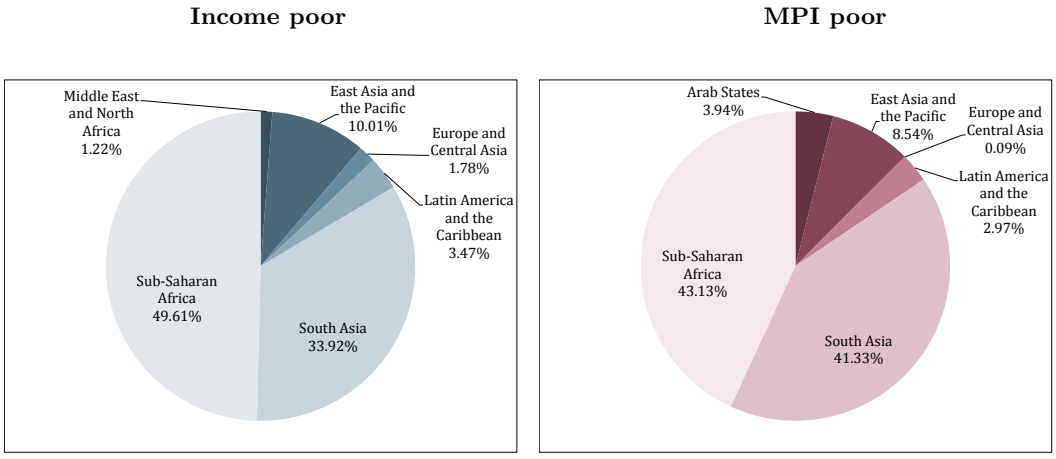
In September 2015, the Member States of the United Nations adopted the 2030 Agenda for Sustainable Development, with seventeen Sustainable Development Goals (SDGs) as a road map to guide countries towards the achievement of a 'sustained, inclusive and environmentally friendly development' (United Nations, 2018). Since their adoption, countries have started incorporating them into their national plans, and designed policies and strategies accordingly. However, four years after the launch of the 2030 Agenda, the first Global Sustainable Development Report (GSDR) suggests that transformations still need to be made in order to account for the interlinkages across all SDGs and accelerate progress towards their achievement. Particularly, it identifies six entry points, of which the first one calls to enhance human well-being and capabilities as to attain the first and most ambitious sustainable development goal of 'ending poverty in all its forms everywhere' (United Nations, 2019).

Indeed, human well-being has improved in the last decades but extreme deprivations are persistant and progress has been unevenly distributed around the globe (United Nations, 2019). The incidence of income poverty in developing countries, as measured by the percentage of population living with less than $1.90 per day, was 11.2% in 2013, which corresponds to 800 million people worldwide.[6] Its distribution is concentrated, with Sub-Saharan Africa and South Asia being home of around 80% of the income poor (figure 0.0.1).

However, poverty is more than the lack of income an individual would need to meet her/his basic needs (United Nations, 2018). It can be manifested as the deprivation of basic capabilities that would enable an individual to be well educated, well nourished, live in good housing conditions or not suffer from persistent disease, for instance (Wang et al., 2016). Accordingly, when poverty is measured using the Multidimesional Poverty Index (MPI) that accounts for the multiple overlapping deprivations that poor people may experience, 1.3 billion people across 101 developing countries worldwide – 23.1% – are considered poor in 2019 (OPHI, 2019). Its distribution is also unequal, with more than 80% of multidimensionally poor living also in Sub-Saharan Africa and South Asia (figure 0.0.1).

[6] Calculation done using World Development Indicators database.

Figure 0.0.1 – Distribution of incidence of multidimensional and $1.90/day poverty by region



Source: Oxford Poverty and Human Development Initiative and World Development Indicators.

When one compares the decrease in poverty rates by region (figure 0.0.2), it is possible to notice that East Asia and the Pacific and Sub-Saharan Africa have made larger progress in increasing the share of the population living with more than $1.90/day between 2010/11 and 2014/15 than reducing the percentage of people facing multiple overlapping deprivations. Meanwhile, Latin America and the Caribbean is the region where the decrease in the incidence of multidimensional poverty between 2008/09 and 2012/13 has exceeded that of income poverty. On the other hand, South Asia has reduced both types of poverty equally. Figure 0.0.2 also shows that, although progress has been made, the share of multidimensional poor remains higher than that of income poor across the four regions considered. This suggests that a significant part of the population might be living above the income poverty line but be facing overlapping social deprivations, such as living in a household with poor housing materials, lack of education, poor health and nutrition and access to unsafe sources of drinking water, for instance.

Both measures capture different concerns of the human well-being of individuals, and thus they identify poverty differently. While the $1.90/day reflects the monetary aspects of poverty, the Multidimensional Poverty Index makes reference to the non-monetary or social aspects. Therefore, both measures seem to complement each other and, by doing so, they are powerful tools to track progress towards the achievement of the first SDG (United Nations, 2019).

One of the levers that the GSDR suggests to deploy in order to bring about the necessary transformations through the progress of the SDGs, and particularly through the advance of human well-being and capabilities, is to improve economic policy and financial flows. In this sense, encour-

aging official development assistance (ODA) towards sectors and activities that build up human well-being remains essential in many developing economies (United Nations, 2019).

Total ODA and official aid received by developing countries has been increasing since disbursements were first deployed in 1960, with three waves characterising its path: between 1960s and the begining of 1970s; between 1972 until the end of 1990s and from 2000 onwards, to achieve an amount of $160.8 billion in 2017 (figure 0.0.3). This expansion of development aid has been unevenly distributed, with South Asia, Sub-Saharan Africa, Middle East and North Africa, and East Asia and the Pacific receiving the largest shares during the first two waves of disbursements, and Europe and Central Asia and other countries increasing their share during the last two decades. Sub-Saharan Africa was in 2017 the region that received the largest share of aid disbursements, followed by other regions, and the Middle East and North Africa (figure 0.0.3).

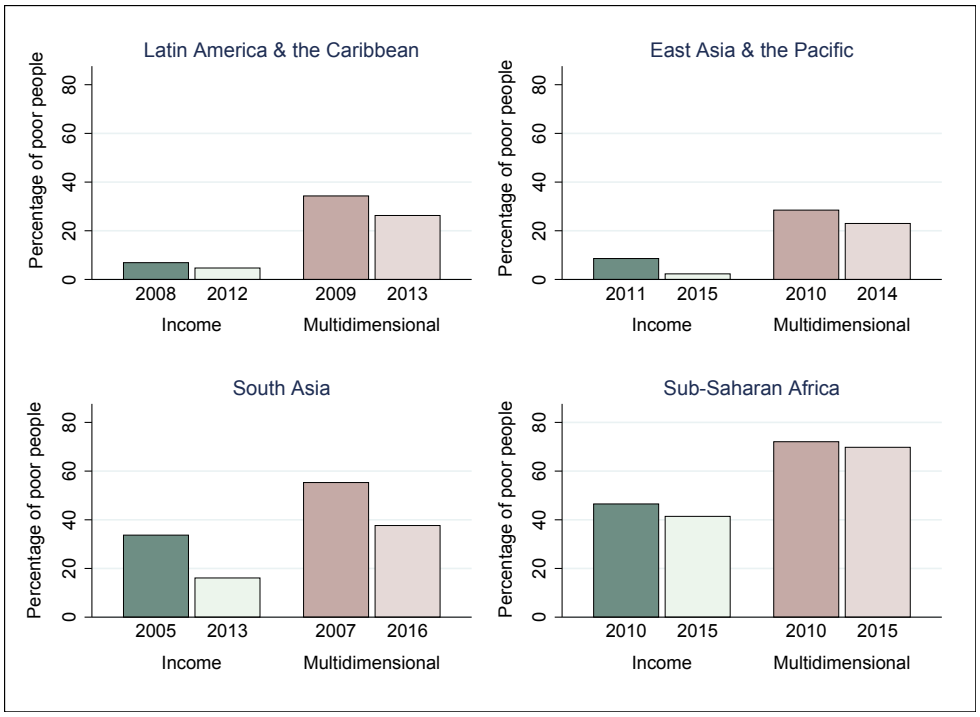
However, despite the enormous amount of aid that the developing world has received, figures 0.0.1 and 0.0.2 show that a significant part of the population in these countries still does not have enough income to cover the basic needs – 11.2% – and more than the double is still multidimensional poor – 23.1%. Thus, a first research question is raised here: will more aid contribute to reduce poverty?

When looking closer at the composition of the Multidimensional Poverty Index, one can also understand how poor people are by means of the ten indicators that hereby are measured, of which the first one identifies whether an individual lives in a household where any person under 70 years of age (for whom there is nutritional information available) is undernourished (OPHI, 2018). From the 1.3 billion people who are identified as multidimensional poor in 2019 across 101 developing countries worldwide, 27% live in households where at least one person under the age of 70 is undernourished. Figure 0.0.4 shows that most of them live in Sub-Saharan Africa and South Asia.

This is particularly relevant since another entry point that the Global Sustainable Development Report identifies is to improve global food systems and nutritional patterns, as to achieve the second Sustainable Development Goal of 'ending hunger, achieve food security and improved nutrition and promote sustainable agriculture' (United Nations, 2019).

Indeed, the global food system is an interlinkage between food production, food-related activities and their interaction with the available natural resources and the process through which food is produced (United Nations, 2019). To date, billions of hectares of land have been degraded, bad agricultural practices are leading to water, soil and environmental pollution, and concentration of food production is scaling up, risking the resilience of the global food system and the supply of proper food to the world's population. People living in rural areas face increasing difficulties to live

Figure 0.0.2 – Evolution of incidence of multidimensional and $1.90/day poverty by region

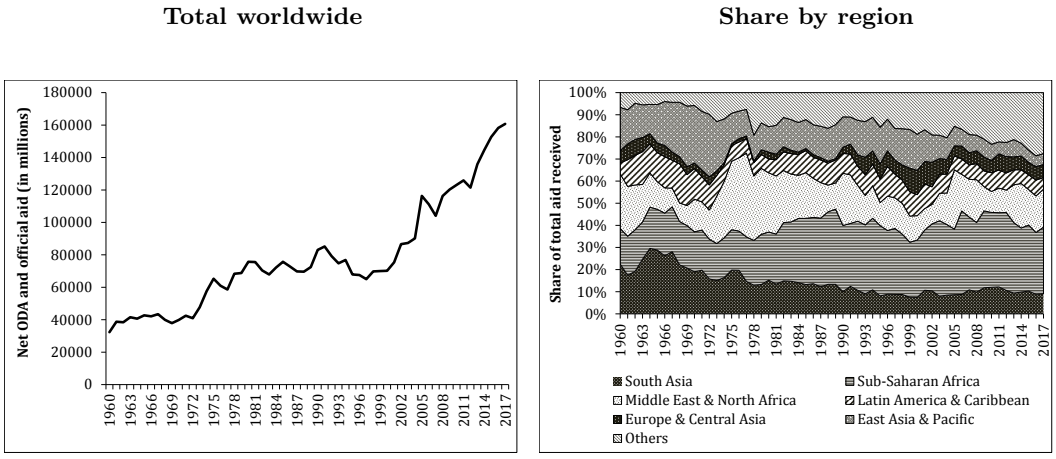


Source: World Development Indicators and Oxford Poverty and Human Development Initiative.
Note: for Multidimensional Poverty, the region of East Asia and the Pacific is represented by Cambodia and Viet Nam; the region of Latin America ad Caribbean is represented by Haiti and Peru; the region for South Asia is represented by Bangladesh, India and Pakistan; and the region of Sub-Saharan Africa is represented by Democratic Republic of Congo, Ethiopia and Nigeria. Further information on the selection of countris can be found in Alkire et al. (2019).

from their agricultural lands, being forced to migrate to urban areas in search of job opportunities that enable them to complete their family income (United Nations, 2018). Under this current scenario, around 2 billion people worldwide is experiencing some level of food insecurity, lacking access to nutritious and sufficient food. They are, thus, at risk of facing various forms of undernutrition and the most vulnerable population, women and children, are paying the higher price (FAO, 2019).

According to the World Bank, 10.8% of children under five years of age worlwide were undernourished in 2017, with a prevalence of stunting of 22.2% and of wasting of 7.5%. Nearly two out of five stunted children live in South Asia, while one in three lives in Sub-Saharan Africa. Latin America and the Caribbean region has percentages of stunted children which are far behind the South Asian and Sub-Saharan African levels – 9.6% on average, versus 35% and 34%, respectively

Figure 0.0.3 – Net ODA and official aid received



Source: World Development Indicators.
Note: Net ODA and official aid in constant 2016 US$.

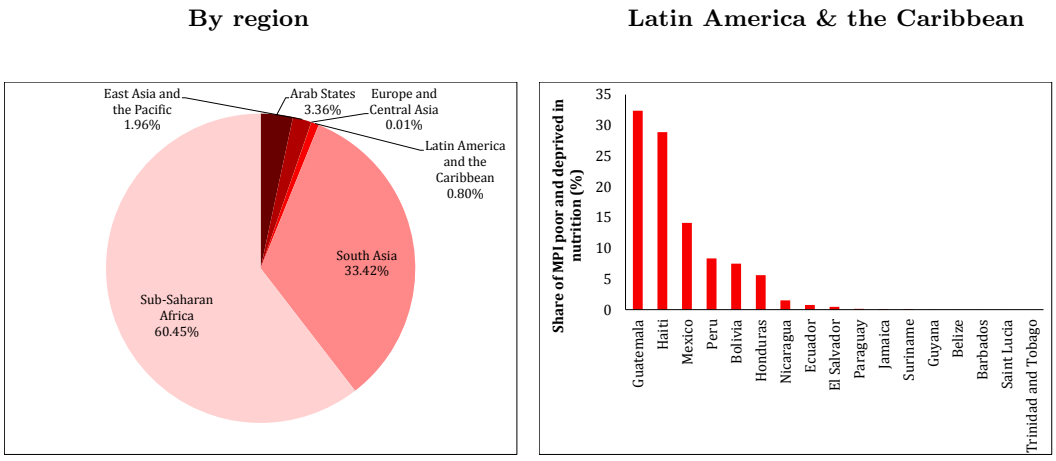
(UNICEF and WHO and World Bank, 2018) –, with a unique exception: Guatemala. According to MSPAS and INE and Segeplán (2017), 46.5% of children under five years of age were stunted and 12.6% faced a situation of underweight in 2014/15. Additionally, figure 0.0.4 shows that out of the total number of individuals who are multidimensionally poor and deprived in nutrition within the Latin America and the Caribbean region in 2019, the largest share – 32.4% – lives in Guatemala.

Guatemala is the most populated country in Central America with almost 17 million people in 2017, of which 50.5% leaves in rural areas (INE, 2014). It is administratively divided in eight regions and twenty two departments and its vast biodiversity englobes fourteen ecoregions with five different ecosystems. The country is populated by a variety of ethnic, cultural, racial and linguistic groups. According to the last National Maternal and Children's Health Survey (ENSMI)[7] of 2014/2015, about 44.4% of the mothers are indigenous, full Amerindian ancestry, which is among one of the largest percentage in Latin America, behind only Peru and Bolivia. Most indigenous Guatemalans descend from Maya people. Although the Spanish is the official language, there exists at least 24 Maya languages, each one belonging to an ethnic group: K'iche' (11.0% of the total population), Q'eqchi (8.3%), Kaqchikel (7.8%), Mam (5.2%), and "other Maya" (7.6%). Less than 1% are indigenous non-Maya (MSPAS and INE and Segeplán, 2017).

The country is classified as lower middle income country and its per capita Gross National Income in 2018 was US$ 3,104[8] (World Bank, 2017). Yet it has the lowest Human Development Index

[7] Encuesta Nacional de Salud Materno Infantil.
[8] PPP constant 2010.

Figure 0.0.4 – Share of MPI poor and deprived in nutrition



Source: Oxford Poverty and Human Development Initiative.

in Latin America after Haiti and Honduras, 0.650 for 2017.[9] Poverty and inequality are still highly persistant and among the highest in the region of Latin America and the Caribbean: the latest available data for the year 2014 indicates that the level of inequality, as measured by the Gini Index, was of 48.3[10]; the proportion of the population in 2014 that was identified as multidimensionally poor was 28.9%, the second highest in Latin America after Haiti; and the share of the population living with less than $1.90 per day was 8.7%[11], mainly concentrated among the indigenous and rural population (Rios and Berania, 2015).

One of the pressing problems in Guatemala is the hoarding of the land, which reduces the availability for food crops. The Gini Index referred to the concentration of land tenure and ownership is the second highest in Latin America and according to the last National Agricultural Census of 2003 is 0.84. This manifests in the fact that 92.1% of small producers cultivate 21.9% of the agricultural area with an average of 2 hectares per property, while 1.9% of commercial producers cultivate 56.6% of the agricultural land, with an average of 137 hectares per property (INE, 2004). This is indeed a historical problem that led to 36 years of civil war and agrarian conflict between 1960 and 1996, arguably the region's bloodiest conflict that claimed more than 200,000 lives, massacred entire indigenous communities and displaced more than 1 million people (CEH, 1999, REMHI, 1999, Solomon and Bailis, 2013). The conflict was originated by the military coup d'etat (supported by

[9] Available data at http://hdr.undp.org

[10] The Gini Index goes from 0, perfect equality, to 100, perfect inequality. Further information available at World Bank PovcalNet.

[11] Data drawn from the latest available tables on the Global Multidimensional Poverty Index (MPI) 2019 at https://ophi.org.uk/.

the CIA) that took place in 1954 against the President Jacobo Arbenz and the Land Reform he tried to implement in order to redistribute agricultural land among the most needed population in South Guatemala (CEH, 1999).

The agriculture sector has been the key driver of economic growth in the last decade (Sanchez et al., 2016). It is characterised by a duality, with a more recent world leading export sector that includes sugar, palm oil, coffee, cardamom and bananas as top six export commodities (United Nations, 2017), and a more traditional one, less productive but more important to indigenous and peasant families, around the production of maize and beans mainly. Indeed, the fundamental basis of food in Guatemala are corn tortillas, which are an institution, and flipped beans. Guatemala's Agricultural Ministry (MAGA) estimates that nearly 0.8 million households are small-scale commercial and subsistence agriculture producers, cultivating corn and beans in almost one-third of the planted agricultural area in Guatemala (Sanchez et al., 2016).

However, while commercial agriculture crops like palm oil and sugar have increased their yields to competitive levels, yields of staple crops, which are produced by the vast majority of poor farmers, are stagnating. This has, in turn, made the country highly dependent on the imports of maize since 2000 (mainly from the United States), becoming a top eight import commodity by 2015 (United Nations, 2017). At the same time, palm oil production in Guatemala has been expanding since the 1980s, becoming the new driver of agriculture production, with the number of hectares cultivated growing at a rate of 17.3% annually since 2003 (CABI, 2017).

Its expansion has initially replaced cotton and cattle plantations in the south-west region, and more recently it has taken place by means of illegal dredging of rivers, the improper use of water resources and the purchase and forced dispossession of communal and family lands of the indigenous population. This not only represents a destructuration of the established order within families and within indigenous communities, but also compromises their access to sufficient food and increases the risk of the most vulnerable population, such as children and women, to face a situation of poor nutritional health (Castro et al., 2015).

Taking into consideration the current context of Guatemala and the call to action as to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture", a second research question deserves to be raised here: are the means through which the agro-export sector is expanding in Guatemala, affecting – to any extent – the nutritional health of the most vulnerable population?

Another lever that the GSDR identifies to achieve successful transformation towards the attainment of the SDGs, and that could be a particularly powerful agent of change in improving the

nutritional patterns of those groups in Guatemala who are most at risk of being left behing, is to reinforce individual and collective action. In this sense, advance women's empowerment and enhance their capabilities through policies and social programmes that enable them to influence their own lives as well as those of their communities, is an essential tool towards sustainable development (United Nations, 2019).

Indeed, there exists a large stream of literature analyzing the relationship between mother's knowledge and child outcomes in developing countries, that shows the relevance of increasing women's general education on the improvement of children's health. For instance, Glewwe (1999) found that, in Morocco, schooling plays a fundamental role for mothers since it indirectly allows them to be able to get health knowledge, which, in turn, is the most important skill that mothers have to take care of their children's health. Chou et al. (2010), instead, evaluated a policy intervention which took place in Taiwan in 1968, intended to extend compulsory education from 6 to 9 years, and which opened over 150 new junior schools at a differential rate among regions. They found that mothers' schooling causes favorable infant health outcomes. An increase in schooling lowers the probability that an infant will be born light or will die in the neonatal or post-neonatal periods. Another study done in rural India by Imai et al. (2014), finds that increasing mothers' education relative to fathers is associated with better nutritional status of children.

Additionally, an study conducted in rural Malawi by Fitzsimons et al. (2016), shows how the implementation of a health program aimed at providing information on child nutrition to mothers, contributes to children's better physical growth. The program consisted in training local women, who visited mothers both before and after the birth of the child, and also provided information on infant feeding. Through the analysis of the collected data, the authors find evidence of improvements in children's diet and household food consumption, in particular through the increase of protein-rich meals, fruits and vegetables.

Since 2001, a similar program is being implemented by the Foundation FUNDAP in the North-West and South-West regions of Guatemala. The program, which is called "Volunteers in Health", operates at the community level and builds capacity by training individuals (90% women) on issues related to child nutrition and basic nursing. Once the volunteers complete their training, they start providing a service to mothers and children, "The Nutritional Recovery Cycles", through which they improve mothers' knowledge on feeding practices and child's health, supply food and vitamins to children, and monitor their growth during six months. In this sense, the volunteers sustain mothers during the first years of life of the child, usually becoming the closest reference mothers have to help them raise their children. Acquiring this specific knowledge and being able to transmit it to mothers results in potential empowerment of women in this critical area of the country, where ignorance about fertility, birth control methods, hygiene and nutrition is still high.

Aknowledging the valuable work the team of the Foundation FUNDAP and the Volunteers in Health are carrying out in order to reduce the prevalence of child undernutrition in West Guatemala, and its relevance towards the achievement of the second SDG, the third research question this Thesis raises is the following: does the increase of women's education and mother's knowledge, contribute to improve the nutritional health of children in West Guatemala?

By answering the three questions raised in the preceding lines, this Thesis seeks to provide greater understanding on the determinants of poverty and well-being in developing countries. Starting with national data, to deepen the analysis using individual and household level data, this Thesis explores the types of social deprivations that characterize poverty and the factors that have a significant impact on some of them, such as the nutritional health of children. It begins with a macroeconomic analysis for 64 developing economies, to continue with an analysis based on survey data for Guatemala, and finalizes with an impact evaluation using more specific individual data from the health program implemented by the Foundation FUNDAP in the western regions of the same country.

The three chapters around which this Thesis is articulated are the following:

- **Chapter 1: Does Aid reduce Poverty?**

The question whether aid contributes to reduce poverty in recipient countries has been analyzed, from a macroeconomic perspective, for over fifty years, without being able to produce conclusive results (Clemens et al., 2004, McGillivray et al., 2006, White, 1992). The lack of reliable data on poverty and the analytical difficulties encountered when seeking to disentangle the causal relationship between aid and poverty, remain the main challenges to address. Chapter 1 reviews the wide literature on the topic and introduces two solutions in order to fill the gaps left open.

The first one is to use the new and original data on multidimensional poverty from Oxford Poverty and Human Development Initiative (OPHI)[12], which provides detailed information on the various social deprivations poor people can experience. By doing so, I am able to analyse the relationship between aid and poverty – instead of proceeding as the previous literature has done, by using economic growth as a proxy for poverty alleviaton – and, thus, consider additional factors – other than income – that affect the well-being of people worldwide: education, health and quality of life (World Bank, 1998).

Additionally, in order to confront the second challenge, I exploit the differences in the number of years countries have been temporary members of the United Nations Security Council (UNSC)

[12]Research Centre at the Oxford Department of International Development (ODID) of the University of Oxford: https://ophi.org.uk/

as an instrument for the average amount of economic aid disbursed by the United States. Indeed, the disbursements of aid towards developing countries, was initiated by the United States in 1946, when the UNSC was first created and aid was thought to be the channel through which developing countries could enhance economic growth. Instead, previous studies suggest that the amount of aid disbursed by the United States during the period 1946-1999 was particularly characterised by politic and diplomatic decisions on international security and, hence, not intended for development in the first place (Kuziemko and Werker, 2006, Meernik et al., 1998).

For a sample of 64 developing countries, I estimate a significant relationship between higher amounts of aid received during the period 1946–1999 and lower Multidimensional Poverty Index (MPI) between 2000 and 2014. On the contrary, the relationship does not seem to be significant when poverty is measured from an income perspective. These results, which are robust to different specifications and sensitivity checks, suggest that alternative measures of poverty could help improve the understanding of the relationship between development aid and poverty alleviation and might also contribute to improved targeting for aid disbursements.

- **Chapter 2: The Impact of the Expansion of African Palm Crop on Child Undernutrition in South-West Guatemala**

Chapter 2 focuses on evaluating to what extent the means through which african palm is being expanded in the South-West region of Guatemala, is affecting food and nutrition security of the most vulnerable population, measured by the increase in the probability of children being undernourished. Castro et al. (2015) and Hurtado (2008) document how the expansion of this monoculture since 2010 is hoarding family and communal agricultural lands as well as water resources, essential for the production of food for the own consumption of indigenous families and for them to sell in internal markets. This also affects other landless peasant families that used to rent part of these lands for the production of staple grains, forcing them to migrate and relocate themselves in a more precarious way in some other place.

Most of the time, men - but also women and children – are employed in oil palm farms, under excessive and poor labor conditions, which entails an increase and lengthening of daily working hours for women, who might be pushed to migrate to urban areas in search of complementary jobs that allow them to complete family income Castro et al. (2015). The pollution of rivers through the discharge of wastewater from the plantations, which has a high content of fertilizers and pesticides, is also documented by Castro et al. (2015) as a practice that is not only jeopardizing regional biodiversity, reducing the availability of fishes, and flooding the agricultural lands of families during the rainy season, but it is also exposing the population of urban and rural areas to harmful substances for their health.

The impact of these practices and also those carried out by the sugarcane industry, on the access to land, labor conditions, the misuse of water resources and forced displacement of indigenous communities in Guatemala, has previously been described in Tomei (2015) and Alonso-Fradejas et al. (2008). Within the Latin American and the Caribbean region, Ávila-Romero and Albuquerque (2018) and Sabogal (2013) provide empirical evidence on how the expansion of african palm cultivation in Brazil, Mexico and Colombia is being carried out through similar practices to those taking place in Guatemala, and how this is increasing economic dependence on the production of cash crops – at the expense of food crops for local consumption –, among the local communities affected. However, no study has yet analysed the impact on food security, particularly when measured by the nutritional health of children, which in the context of Guatemala represents a pressing matter.

The analysis provided in Chapter 2 seeks to contribute to the literature by filling this gap. Using survey data from the National Maternal and Children's Health survey and a difference-in-difference empirical strategy, I estimate a significant increase in the probability of children under five of being chronically undernourished when they live in any of the two departments of the South-West region of Guatemala – Quetzaltenango and San Marcos –, which are particularly affected by the expansion of african palm since 2010. Children from indigenous mothers, living in urban areas and in a household where the head of the family is a man, are those most negatively affected. These results, which are robust to different specifications and to an alternative estimation method, suggest that improving the global food system of Guatemala as to include the participation of the peasant indigenous economies, could contribute to end hunger, achieve food security through better nutritional patterns, and promote a sustainable agriculture that protects water and land resources.

- **Chapter 3: It Takes a Village to Raise a Child. Women's Education, Mother's Knowledge and Child Undernutrition in Indigenous Guatemala**

In order to understand a bit more the possible solutions to the high prevalence of undernutrition in Guatemala, Chapter 3 carries out an impact evaluation analysis of a health intervention program directed towards children under five in the west regions of the country. This study is one of the few that has been performed on this topic within the Guatemalan context. For instance, Marini and Gragnolati (2003) use survey data to describe the socioeconomic, geographical and ethnic factors that characterize child undernutrition in the country. Authors find that within poor, rural and indigenous families, with low levels of education, are those where poor nutritional health among children prevails the most. As possible solutions, they suggest that action should focus on increasing nutritional interventions, and improving the access to basic services and to education of the guatemalan population. The study done by Maluccio et al. (2009) contributes to shade light on the effect of an early childhood nutritional intervention on adult economic outcomes by showing how the provision of nutritional supplements to children could improve their cognitive abilities in the

long run.

Using unique and valuable information of children under five years of age, that have participated in the nutritional recovery cycles implemented by Volunteers in Health in West Guatemala, Chapter 3 provides new evidence on the relevance of providing nutritional education and food supplementation to improve children's health. The analysis is performed in two steps. First, it focuses on evaluating the effectiveness of the program between 2015 and 2018, by measuring the advance of children's health outcomes with each additional visit received by the volunteers during the six months that the intervention lasts. And second, it shows how the probability of children being underweight in 2015 decreased significantly when their growth was monitored by the volunteers and mothers received information on how to improve the nutritional practices towards their children, by using additional information from a national survey to build a comparison sample of children that did not participated into the nutritional recovery cycles.

Main results, which are robust to several specifications and a falsification test, suggest that the nutritional intervention implemented by the Foundation FUNDAP in the west regions of Guatemala, contributes significantly to reduce the prevalence of underweight among children under five years of age. They point out how the definition of ad-hoc policies operating at the local level and involving the participation of all members of the communities – and women, specifically – could be particularly effective in reducing child undernutrition. This work underlines how educating women – a strong empowerment factor – at the community level, to provide information on infants' nutrition to mothers, together with the monitoring of children's growth and the supply of food supplements, represents a powerful instrument to end hunger and leave no one behind in western Guatemala.

Through the analyses and the results hereby presented, this Thesis hopes to highlight several paths to achieve the two first goals of the Agenda 2030, and inspire social and political actions that enhance human well-being and capabilities, as for every individual in the world could enjoy life with dignity.

Chapter 1

Does Aid Reduce Poverty?

1.1 Introduction

Whether aid contributes to a reduction in poverty among recipient countries is a debate that has been on the table for over fifty years.[1] From seminal theoretical works, such as those of Chenery (1967) and Bacha (1990), to the most recent empirical ones, such as Clemens et al. (2012) and Galiani et al. (2017), the analysis of the effectiveness of aid has not yet produced conclusive results.

However, the relevance of this research question has been growing in recent years. The United Nations' Sustainable Development Goals (SDGs) seek to achieve one of the most ambitious goals: 'End poverty in all its forms everywhere' by 2030 (United Nations, 2015). And to attain this, the international community has emphasised the need to reorient poverty-fighting support through a better allocation of Official Development Assistance (ODA) flows (World Bank, 2015). But, despite the enormous amount of aid that the developing world has received (almost US$1 billion on average since 1960), income poverty still represented 14.5% of the world's population in 2011 (World Bank Group, 2014) and multidimensional poverty affects around 30% of people around the globe (Alkire et al., 2016). Therefore, will more aid contribute to reduce poverty?

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[1] For an extensive review of the literature see White (1992), McGillivray et al. (2006) and Clemens et al. (2004).

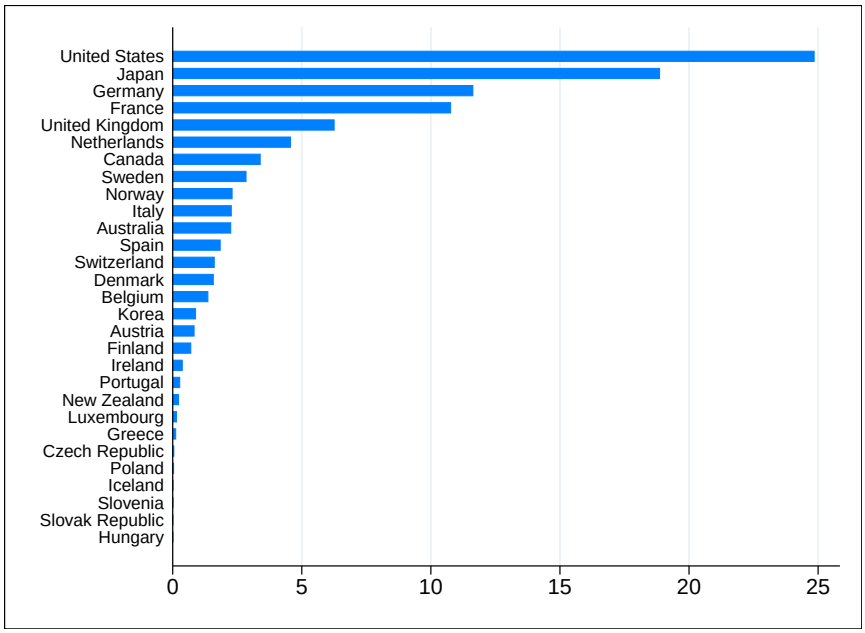
In the present article, I seek to answer this question by closing two gaps left open in previous studies. First, the standard relationship that has widely been analysed in the literature is the one between aid and growth, mainly due to the lack of reliable data on poverty in developing countries. Nonetheless, the link between poverty and economic growth is not direct (Bourguignon, 2004). And, although countries' economies need to grow to alleviate poverty, the power of economic growth is limited, particularly when poverty is measured from a multidimensional perspective (Santos et al., 2017). Hence, analysing the effect of aid on poverty reduction through economic growth does not consider other social factors that indeed affect the well-being of people, such as education, health and quality of life among others (World Bank, 1998). I intend to close this gap by using the new and original database on multidimensional poverty from the Oxford Poverty and Human Development Initiative (OPHI)[2], which provides information about the different forms of deprivation poor people can experience. In particular, I consider the 10 indicators of the global Multidimensional Poverty Index (MPI), and compare MPI results to poverty measured from a monetary perspective. This way, I am able to directly focus on the aid-poverty relationship.

The second gap concerns the empirical strategy used to analyse this relationship. Because lower growth (and higher poverty) might attract more aid, it is difficult to disentangle the causal direction between these two variables. This creates a problem of reverse causality that prevents researchers from properly identifying the causal effect of aid on economic growth (and poverty alleviation). Previous studies, such as Boone (1996), Burnside and Dollar (2000), Rajan and Subramanian (2005) and Clemens et al. (2012) have tackled this issue by using lagged values of aid as instrumental variables of current ones. However, empirical results diverge among these studies, and, considering that poverty levels do not change drastically in the short run, past levels of aid may still introduce some endogeneity bias in the estimations. More recently, Galiani et al. (2017) have addressed this challenge by using the income threshold criterion for aid allocation set by the International Development Association (IDA) as an instrument of the endogenous foreign aid variable and have found that a one percentage point increase in the aid to Gross National Income (GNI) ratio raises per capita GDP growth by 0.35 percentage points on average. Nonetheless, the analysis still focuses on the aid-growth relationship and does not address the impact of aid on poverty reduction.

I aim to complement this literature by using a new instrument of aid disbursements. I exploit differences in the number of years countries have been temporary members of the United Nations Security Council (UNSC) as an instrument for the average amount of economic aid disbursed by the United States between 1946 and 1999. Hence, I only consider the intensive margin, that is, countries that have spent at least one year as a temporary member of the UNSC during that period. Previous work from Kuziemko and Werker (2006) shows that rotating onto the council during the period 1946–2001 has contributed to a 59% increase in the amount of U.S. aid the country has

[2]Research Centre at the Oxford Department of International Development (ODID) of the University of Oxford.

Figure 1.1.1 – ODA Gross Disbursements 1967–2016 (% of total ODA from DAC countries)



Source: OECD Development database

received. Moreover, the authors prove that the effect is particularly pronounced during key years for international diplomacy, suggesting that aid was indeed not due to an increase in attention to a country's needs.

Using cross-section data for 64 developing economies, this article analyses the relationship between the average amount of aid received by a country from the United States over the period 1946–1999 and average poverty levels between 2000 and 2014. There are four main reasons to focus on this empirical strategy. First, the multidimensional poverty data source is only available from 2000 onward. Second, if poverty levels are assumed to have declined in the last three decades (United Nations, 2009a), average poverty over the period 2000–2014 would be less likely to explain selection into the council between 1946 and 1999. Third, it is particularly interesting to exploit aid data that was not directly intended for development purposes since this, together with the second argument, supports the choice of instrument. Finally, focusing on aid flows coming exclusively from the U.S. enables this study to consider aid data since the creation of the UNSC in 1946, compared to other aid sources – such as ODA – that started in the 1960s. Since the U.S. is indeed the main donor among the donor pool of the Development Assistance Committee (DAC) (figure 1.1.1), I am confident of the external validity of the results.

The results obtained from this study suggest that a country received 14.6% more aid from the U.S. on average during the period between 1946 and 1999 when rotating onto the council for at least one additional year and that, despite their low transparency, these flows seem to be significantly related to lower multidimensional poverty on average over the period 2000–2014. In particular, I find that a 1% increase in the average amount of aid received is associated with a 0.61% reduction in the MPI — on average within the sample. When disentangling the associations among the three dimensions considered in the MPI (education, health, and living standards), results suggest that an average increase of 1% in U.S. aid is related to a lower percentage of multidimensionally poor people deprived in education, health and living standards by 0.82%, 0.36% and 0.64%, respectively. On the other hand, I do not observe a significant relationship between aid from the United States and income poverty, measured here by the percentage of the population whose income is below the threshold of $1.90/day (extreme poverty) and $3.10/day (non-extreme poverty) as well as the intensity of poverty. These results are robust to a wide range of specifications and sensitivity tests.

The relevance of these results parallels the use of alternative measures of poverty, such as the MPI, which could help improve the understanding of the relationship between aid and poverty alleviation, other than through economic growth – which has been the primary tool of analysis in previous studies. Moreover, these results might also help to reorient aid disbursements if poverty in all its forms shall be ended everywhere by 2030.

The rest of the paper is organised as follows. Section 1.2 briefly reviews the empirical literature on aid effectiveness and several works on the determinants of aid on which this paper is based. Section 1.3 presents a data description and summary statistics. Section 1.4 introduces the instrument. Section 1.5 presents the empirical strategy and baseline results. Section 1.6 reports a battery of robustness checks. Section 1.7 presents sensitivity tests for the main results. Section 1.8 discusses possible differences between income and multidimensional poverty that could contribute to the understanding of the results found throughout the analyis. Section 1.9 concludes.

1.2 Literature Review

The rather large literature on aid effectiveness has been developed over the last fifty years and has mainly focused on the impact of development aid on economic growth in less developed countries. It can be chronologically classified into three groups: 'it works; it doesn't; it can, but it depends...' (McGillivray et al., 2006). The first two characterise empirical works between the 1960s and the 1990s, which were mainly based on the Harrod-Domar/Financing Gap model and its extensions that included a foreign exchange gap (Chenery, 1967) and a fiscal gap (Bacha, 1990, Taylor, 1991). They mainly aimed at analysing whether the theoretical macroeconomic impact of aid could indeed be found in the data. However, despite the fact that the amount of aid actually exceeded the amount

predicted by these theories,[3] economists observed that anticipated growth was not achieved (White, 1992) and the results obtained generated a huge controversy. Results were inconsistent, with positive *and* negative relationships and even no relationship found between foreign aid and economic growth.[4] Moreover, the controversy was also exacerbated by the presence of a paradox between the positive results summarised at the micro-level and the ambiguous evidence at the macro-level, the micro-macro paradox (Mosley, 1987, White, 1992).

The publication of the World Bank (1998) report and the subsequent Burnside and Dollar (2000) work marked a turning point and a new wave of aid effectiveness studies emerged by the early 2000s, such as Collier and Dehn (2001), Collier and Hoeffler (2004) and Collier and Dollar (2002). These works not only introduced an innovative macro-econometric framework of analysis by addressing the endogeneity of aid through lagged disbursements but they also dealt with non-linear effects and found support for a conditional effect of aid on growth according to the policy regime of the recipient country. This result was indeed widely discussed and studies were then divided between those that concluded that the allocation of aid should be contingent on a sound institutional environment and those that did not arrive at this conclusion. In the latter category we can find works such as Dalgaard and Hansen (2001), Hansen and Tarp (2001), Lensink and White (2001), Easterly et al. (2004) and Roodman (2007).

New controversies stimulated the development of several alternative explanations such as the need to account for the negative and significant impact of uncertainty (as measured by the instability of aid receipts) on economic performance in order to find a positive effect of aid on growth, mainly due to its effect on investment (Lensink and Morrissey, 2000); climate-related circumstances that can either enhance the positive impact of aid on growth (Guillaumont and Chauvet, 2001) or diminish it (Dalgaard et al., 2004); the conditionality of aid effectiveness on political stability and good institutional quality (Acemoglu and Robinson, 2012, Burnside and Dollar, 2004, Chauvet and Guillaumont, 2004, Islam, 2005)[5] and the presence of diminishing returns to foreign aid beyond a certain threshold (Dalgaard and Hansen, 2001, Durbarry et al., 1998, Hansen and Tarp, 2001, Islam, 2005, Lensink and White, 1999)[6].

[3] Aid has grown dramatically in the post-war period, increasing by 4.2% per annum in real terms during the period from 1960 to 1988, to reach nearly US70 billion dollars by 1988. In 1988 prices and exchange rates, almost US1.4 trillion (thousand billion) dollars has been disbursed during the last three decades.

[4] For an extensive review of the literature, see White (1992), McGillivray et al. (2006) and Clemens et al. (2004).

[5] Acemoglu and Robinson (2012) highlight that countries failing to liberalise markets or move towards democracy typically have a greater need for aid. Thus, they will either receive as much aid as those that do meet the conditions or the amount of additional foreign aid will not be worth the risk for the leaders of the extractive institutions who stand to lose their continued dominance over the country. In any case, conditionality would not be the best answer to reduce poverty around the world but perhaps structuring foreign aid in order to bring external groups into the decision-making process of economic development would help.

[6] Absorptive capacity limits differ among the empirical studies, occurring between 5.5% (Dalgaard and Hansen, 2001) and 50% of aid to GDP (Lensink and White, 2001) with an average level of 20.7%. For an extensive review of these results see Table A1 of the Appendix on Feeny and McGillivray (2011)

More recently, Clemens et al. (2004, 2012) argue that aid flows should not be considered in an aggregate manner (as in all previous studies) since significant portions of aid are unlikely to have an impact on growth over the short period usually considered (four years). By analysing the early impact of aid flows (which accounts for about 53% of all aid flows) on economic growth, they find a positive relationship (with diminishing returns) between these two variables. Moreover, their main results are not actually affected by the quality of institutions and policies, as previous studies have found, but the impact on growth seems larger in countries with better institutions or better health (as measured by life expectancy). Rajan and Subramanian (2005) extend previous studies and examine the robustness of the aid-growth relationship across different time horizons (medium and long run), periods (1960s through 1990s), sources of aid (multilateral and bilateral), types of aid (economic, social, food, etc.), timing of impact of aid (contemporaneous and lags varying from 10 to 30 years) and specifications that use both cross-sectional and panel databases with samples that both include and exclude outliers. All in all, the authors' central conclusion is that aid does not impact economic growth, and they find this result robust to different time horizons, time periods, cross-section and panel contexts and different types of aid.

At this stage, and as far as this paper is concerned, all the aid-effectiveness studies have focused on the aid-growth relationship, assuming that higher growth would lead to lower poverty levels. However, the controversial effect of aid on economic growth should not be taken to mean that aid is ineffective for poverty reduction. Instead, empirical work should focus on the aid-poverty relationship (Feeny and McGillivray, 2011). To our knowledge, the only study that has focused on this link is the one by Yontcheva and Masud (2005). The authors analysed the impact of NGO and bilateral aid on human development indicators. Their main findings suggest that NGO aid significantly reduces infant mortality whereas bilateral aid does not seem to play a significant role due to its fungible character, meaning that non-aid-financed government expenditures (health and education, in particular) decline as bilateral aid increases. This, in turn, cancels the potential effect that bilateral aid may have in reducing infant mortality.

Moreover, the new development agenda calls for alternative ways of measuring poverty. With this purpose, OPHI builds data on multidimensional poverty by considering three dimensions of poverty: education, health and living standards.[7] The MPI and its components have been published since 2010 and cover more than 100 developing countries. The construction of this index is done using the Alkire-Foster methodology, which identifies the set of indicators in which each person is deprived at the same time and summarises their poverty profile in a weighted deprivation score (Alkire and Foster, 2011, Alkire et al., 2017). Their findings are that, on average, 30% of people are MPI poor, that is, 50% more than income poor people using the $1.90/day poverty line (Alkire et al., 2016).

[7]For further information, please refer to the Data section.

Santos et al. (2017) use this database to analyse the relationship between economic growth and income and multidimensional poverty. Their findings suggest that there exists a significant association between the three variables but that the impact of growth on reducing multidimensional poverty is far lower than its impact on reducing income poverty: 'growth does not seem to be particularly pro-poor when poverty is measured from a multidimensional perspective'. They conclude that although countries need to grow in order to reduce poverty, economic growth does not result in large reductions in poverty.

Overall, one of the main lessons that it is drawn from the last 50 years of aid effectiveness is that empirical results do not converge and there is still lot of controversy on the effect of aid on poverty alleviation (and on growth). The main challenge is the endogeneity bias that occurs due to reverse causality between poverty (and growth) and aid.[8] As previously highlighted, the way that many studies have tackled this problem has been by using lagged values of aid as instruments for contemporaneous disbursements. However, considering that poverty levels do not change drastically in the short run, past levels of aid may still introduce endogeneity bias in the estimations. As Clemens et al. (2012) highlight 'the aid-growth literature does not currently possess a strong and patently valid instrumental variable with which to reliably test the hypothesis that aid strictly causes growth.'

Recent research by Galiani et al. (2017) supports the conclusion that 'identification of the causal effect of aid on growth has been elusive so far due to foreign aid being endogenous in growth models. An instrumental variable is needed to address these problems'. To analyse the impact of aid on growth, the authors use data on the eligibility for aid from the International Development Association (IDA). Their results suggest that aid, as a share of GNI, drops 59% when a country crosses a per capita income threshold. They focus on 35 countries between the period from 1987 to 2010, and they find that a one percentage point increase in the aid/GNI ratio raises per capita economic growth by 0.35 percentage points on average.

Kuziemko and Werker (2006) provide some insight on a potential, and yet not largely exploited, instrument for foreign aid. They analyse the impact of being elected onto the UNSC on aid disbursements from the United States during 1946–2001. The authors find that the amount of U.S. aid received by a country during that period increased by 59% when it rotated onto the council. Moreover, this effect is more pronounced during key years for international diplomacy. They also find a smaller but still significant increase in aid given by the United Nations through UNICEF, an organisation over which the United States has exerted great control. Their conclusions highlight the political and even *less transparent* character of U.S. aid flows since the creation of the United Nations and until the launch of the Millennium Development Goals (MDGs).

[8] Higher poverty (and lower growth) should attract more aid. It is thus difficult to disentangle the causality relationship between aid and poverty reduction (and economic growth).

Along these lines, Meernik et al. (1998) analyse the role played by three different goals of U.S. foreign policy on the amount of aid distributed during and after the Cold War through an analysis of a panel data set of 127 countries between 1977 and 1994. These goals are systemic security, such as the U.S. overseas military presence; the protection of U.S. allies and the containment of communism; societal economic objectives, such as the protection and expansion of trade and the promotion of open markets abroad; and statist ideological purposes such as promoting democracy, encouraging a respect for human rights and promoting economic development abroad. Although the authors find all three approaches to be relatively important during the Cold War, they show that there has been a shift from security-driven goals towards the ideological ones after the Cold War. Thus, they provide empirical evidence of a change in the intentions of U.S. foreign aid from strategic and diplomatic needs to development promotion in the aftermath of the Cold War.

Considering then that aid disbursement from United States before the 2000s was mainly politically motivated and probably lacking in transparency, this article intends to exploit this data and contribute to the aid-effectiveness literature by analysing the relationship between aid and poverty alleviation.

1.3 Summary Statistics

Table 1.3.1 – Summary Statistics of used variables

Explicative Variables	Obs.	Mean	Std. Dev.	Min.	Max.
Main endogenous explicative variable (avg 1946–1999)					
Economic U.S. aid, millions	64	143.7	303.5	1.6	1,948.7
The instrument (sum 1946–1999)					
Total N° years at the UNSC	64	3.8	2.9	1.0	16.0
Quality of Institutions					
Polity2 (avg. 1946–1999)	64	-1.6	5.1	-8.2	10.0
Political Rights (avg. 1972–1999)	64	4.6	1.5	1.0	6.9
Civil Liberties (avg. 1972–1999)	64	4.5	1.1	1.8	6.9
Ethnic fractionalisation (1 year in 1979–2001, country specific)	63	0.6	0.2	0.0	0.9
Language fractionalisation (1 year in 1979–2001, country specific)	63	0.5	0.3	0.0	0.9
Religious fractionalisation (1 year in 1979–2001, country specific)	64	0.4	0.3	0.0	0.8
Growth and size of the country (avg. 1960–1999)					
Annualised per capita GDP growth (constant 2010 US$), %	64	0.8	1.9	-7.2	4.6
Population Density	64	65.2	96.5	1.3	652.3
Per capita GDP (constant 2010 US$)	64	2,448.3	3,156.9	263.3	16,394.7
Trade (as % GDP), %	64	58.4	29.3	13.5	147.4
Public consumption & relative size of aid received (avg 1960–1999)					
Government Consumption (as % GDP), %	63	14.4	5.3	6.0	31.8
U.S aid (as % total received), %	60	24.6	18.5	2.1	80.4
Dependent Variables (avg 2000–2014)					
MPI, %	64	19.5	17.2	0.0	62.3
Multidimensional Poverty HR, %	64	36.2	28.9	0.0	90.8
Income Poverty Gap ($PPP3.10/day), %	58	21.3	17.3	0.1	66.7
Income HR ($PPP3.10/day), %	58	46.2	30.0	0.1	94.5
Income HR ($PPP1.90/day), %	58	21.3	17.3	0.1	85.6
Income Poverty Gap ($PPP1.90/day), %	58	10.8	11.2	0.0	51.4

Notes: HR stands for headcount ratio. As explained variables, we also analyse the 10 indicators that compose the MPI and whose descriptive statistics are available in Table 1.B.3 of the Appendix: years of schooling, child school attendance, child mortality, nutrition, electricity, improved sanitation, drinking water, flooring, cooking fuel and asset ownership.

This study focuses on the impact of average U.S. aid for the period 1946 to 1999 on average values of poverty from 2000 to 2014. The dynamic constraint is related to data on multidimensional poverty, which is available from 2000, for only a few years, and, in some cases, there exists just one observation per country. Survey years for income poverty also differ across countries and across measures. Following Kuziemko and Werker (2006), I only consider developing countries that have at least spent one year as a temporary member of the UNSC during the period from 1946 to 1999. I match these countries with available data on multidimensional poverty, and end with a group of 64 developing countries, for which I build a cross-sectional database.[9] The sample includes 8 countries from Asia, 6 from Eastern Europe, 14 from Latin America and the Caribbean, 3 from the Middle East, 3 from North Africa and 30 from Sub-Saharan Africa. Table 1.3.1 gives descriptive statistics of the main dependent and explicative variables used in the study.[10]

1.3.1 Main dependent variables

The main dependent variables that are analysed are the MPI, which is transformed into a percentage for easier comparison across alternative measures; the multidimensional poverty (censored) headcount ratio; the income poverty gap and income headcount ratio at $1.90/day (PPP) and $3.10/day (PPP), which are comparable to the MPI and the headcount ratio for multidimensional poverty, respectively (Santos et al., 2017). The study also analyses the 10 indicators of the MPI.[11] Multidimensional poverty data is from OPHI.[12] Income poverty data is from the World Development Indicators database.

The MPI captures the severe deprivations that people face in three dimensions of poverty: education, health and living standards.[13] The deprivation score for each person is constructed based on a weighted average of the deprivation they experience in each indicator, and the person is considered multidimensionally poor if the deprivation score meets or exceeds the 33.33% threshold. The global MPI covers 110 countries and 5.4 billion people. On average, 30% of people are MPI poor, that is 50% more than income poor people using the $1.90/day (PPP) (Alkire et al., 2016).

1.3.2 Endogenous explicative variable

Data on U.S. economic aid is extracted from the "Greenbook", which is the U.S. Overseas Loans and Grants database complied by the U.S Agency for International Development. Contrary to

[9] Refer to table 1.B.5 in the Appendix for detailed information on the survey years for multidimensional and income poverty by country and region, as well as the total number of years at the council and average aid received from the U.S.

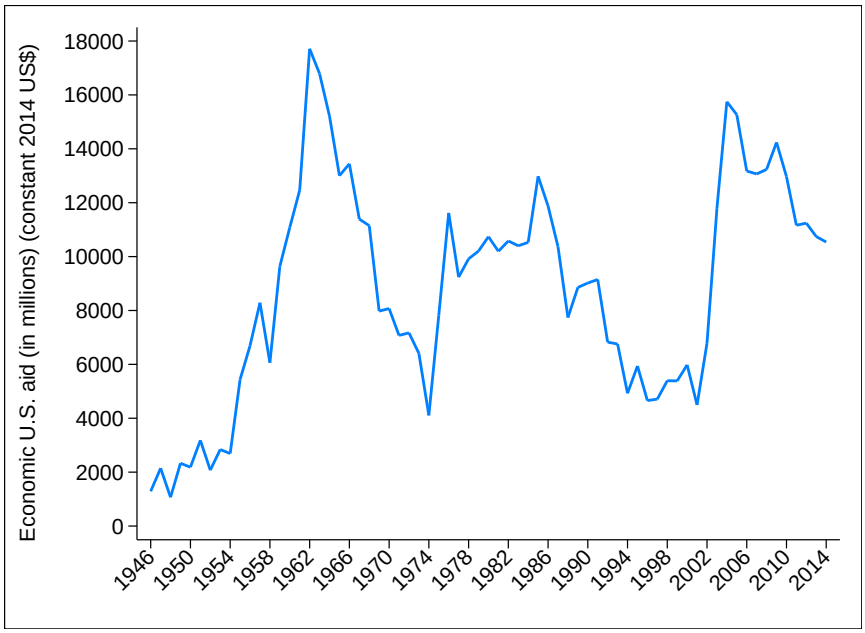
[10] Table 1.B.2 in the Appendix gives detailed information about the data, description and sources and table 1.B.4 provides the correlation matrix.

[11] Details of these indicators are given in table 1.B.1 of the Appendix.

[12] For further information, please visit their website at http://www.ophi.org.uk/. Data is extracted from Table 7 'All Published MPI Results since 2010'.

[13] Table 1.B.1 gives a detailed description and the cutoffs for each indicator considered in the MPI, and table 1.B.3 provides the summary statistics.

Figure 1.3.1 – Aid to countries in the sample



Source: U.S Agency for International Development

Kuziemko and Werker (2006), I only consider economic aid disbursements[14] and not military aid in order to focus the analysis on the role of aid intended for development.[15] U.S. data on aid is available since the creation of the United Nations in 1946. Thus, by using it, I am able to consider the total amount of economic aid given by the United States before the 'formalisation' of development assistance in the 1960s.[16]

Also, by using U.S. aid during the 1946–1999 period, I consider specific and politicised disbursements that were characterised by diplomatic decisions on international security (Kuziemko and Werker, 2006, Meernik et al., 1998), whereas the implementation of the MDGs in 2000 reoriented the aid strategy toward the countries with the greatest needs (Radelet, 2004). Figure 1.3.1 shows the evolution of U.S. economic aid towards developing countries between 1946 and 2014.

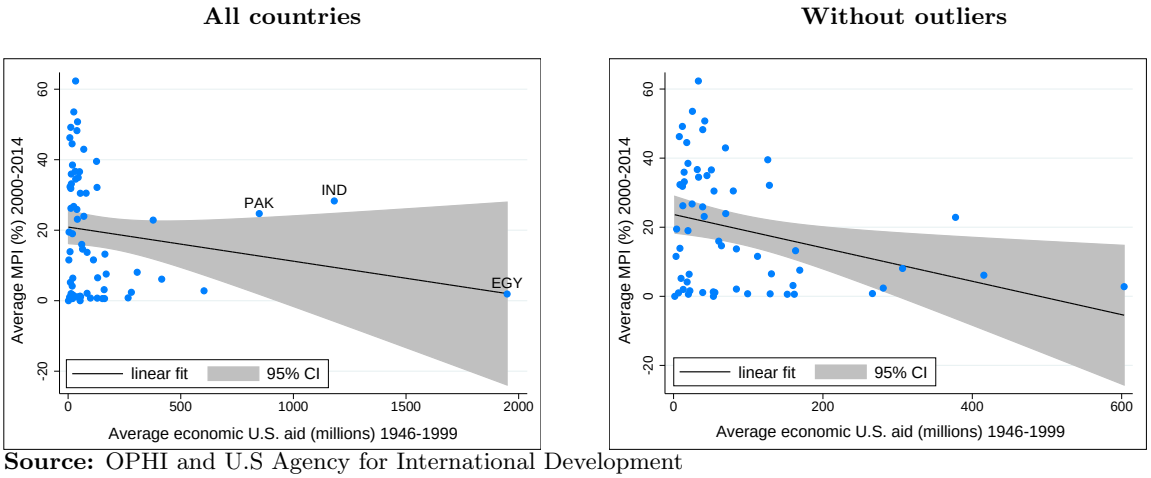
The first big increase in the aid program was in 1955, when Dwight D. Eisenhower became Pres-

[14] Only positive values of aid are considered, thus gross disbursements.

[15] This aid is classified within different purposes such as 'economic and security support assistance', 'food for education', 'refugees and migrations' and 'global health and child survival' to name a few. Therefore, it encompasses the whole amount of development aid given by the United States to each developing country.

[16] Although the study only considers U.S. aid as the main explicative variable, robustness of results is tested by adding the share of U.S. aid over the total official development assistance (ODA) received by each country over the 1960–1999 period (in %) as a control.

Figure 1.3.2 – U.S. economic aid and MPI



Source: OPHI and U.S Agency for International Development
Note: country abbreviations are for Pakistan (PAK), India (IND) and Egypt (EGY).

ident of the United States and the Warsaw Pact was founded in Eastern Europe as a Communist military counterpart to NATO. Foreign aid from the U.S. starts to decrease and reach its first low in 1973, during the first oil crisis, then rises again before decreasing again in the 1990s. The main reasons for this decline that are stated in the World Bank (1998) report are increased control of fiscal deficits among OECD countries, the end of the Cold War and the rapid increase in private flows to developing countries. Flows reached their second low in 1997 before increasing drastically after the publication of the World Bank (1998) report and the implementation of the MDGs by the United Nations. Indeed, the main findings of this report underlined the importance of sound policies, institutions and economic management as key factors for aid effectiveness. Acknowledging the large decline in aid flows during the 1990s, the authors of the report firmly encouraged continued aid from the donor community, claiming that the 'climate for effective aid is the best that it has been in decades'.[17]

Figure 1.3.2 shows the relationship between the amount of U.S. aid received and the MPI. There are three outliers that seem to diminish the relationship between these two variables. Egypt, India and Pakistan have all three received significantly high amounts of U.S. aid, but Egypt registers a relatively low level of poverty whereas India and Pakistan have relatively high levels of poverty. Nonetheless, when controlling for these outliers, there seems to exist a negative and relatively high correlation between the amount of U.S. economic aid received and the level of multidimensional

[17] Pp. 2 and 3 of the report state that a '$10 billion increase in aid would lift 25 million people a year out of poverty – but only if it favors countries with sound economic management' and 'there have been sharp improvements in governance and policies in the past decade, but further reform of the same magnitude would lift another 60 million people a year out of poverty'.

poverty of the country (-0.32).[18]

1.3.3 Potential macroeconomic determinants of poverty

Building on previous literature (Burnside and Dollar, 2000, Dalgaard et al., 2004, Kuziemko and Werker, 2006, Lensink and White, 2001, Santos et al., 2017), three sets of controls are used: quality of institutions, growth and size of the country, and public consumption and relative size of aid received.

The main measure of political and institutional quality is the polity 2 variable from the Polity Project of the Center for Systemic Peace (Marshall et al., 2017). Its score ranges from -10 to +10, and it examines qualities of democratic and autocratic authority in governing institutions that span from fully institutionalised autocracies (-10 to -6) to fully institutionalised democracies (+6 to +10), with an intermediate and mixed authority regime called anocracy (-5 to +5). As alternative measures of institutional quality I have used Political Rights and Civil Liberties from Puddington and Roylance (2016). The ratings range between 1 for the most free conditions and 7 for the least free, and they assess the real-world rights and freedoms enjoyed by individuals rather than government performance.[19]. Other variables of political economy that are used are ethnic, language and religion fractionalisation, constructed and provided by Alesina et al. (2003) These measures represent the proportion (between zero and one) of each respective fragmentation within the population. The higher the percentage is, the higher the fragmentation.

Proxies for economic growth and the size of the country include population density, per capita GDP, per capita GDP growth and trade (as % of GDP). Data is drawn from the World Development Indicators (WDI) database. These control variables are not only relevant as potential poverty determinants, but also as potential factors explaining selection into the council. Therefore, controlling for these variables should reinforce the exclusion restriction condition for the validity of the instrument that I use. Finally, and as a robustness check, I include in the main equation the ratio of U.S. aid over the total amount of aid received by the country (OECD database) in order to control for its relative size and the potential crowd in/out effect on the amount of aid coming from other countries. I also test robustness by controlling for government consumption (as % of GDP) from the WDI database, as a proxy of public consumption and a factor that may affect the effectiveness of development aid (see for instance Addison and Tarp (2015).

[18]The outliers with respect to the income poverty-aid relationship are India and Pakistan (there is no data on income poverty for Egypt) (figures 1.A.1 and 1.A.2 in the Appendix).

[19]See Puddington and Roylance (2016) for further information about these variables.

1.4 The Instrument

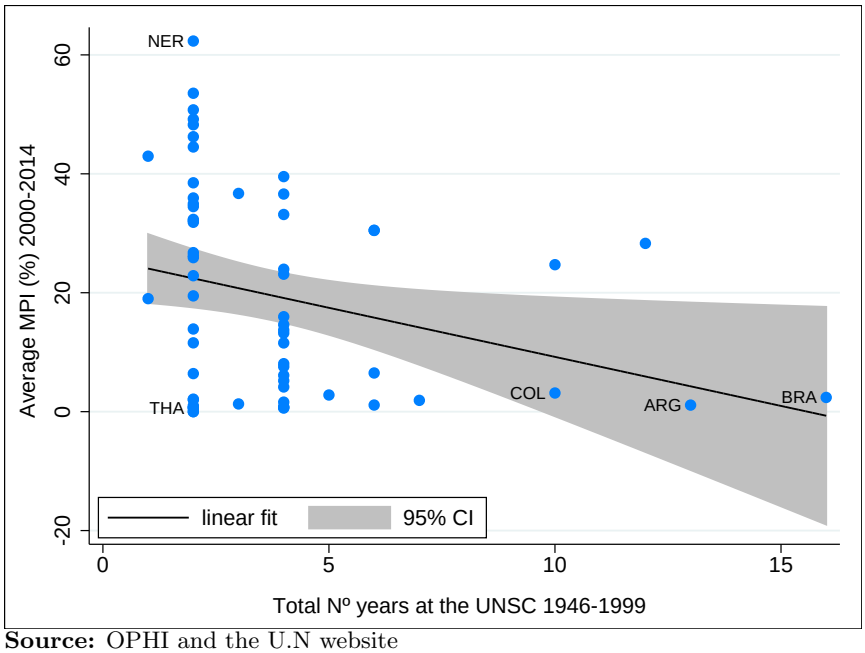
Ten out of fifteen seats of the UNSC are held by rotating members serving two years. The other five are the permanent seats of the Russian Federation, France, the United States, the United Kingdom and China. Potential reasons lying behind the assignment of a temporary seat may be to increase attention to a country's needs, greater integration in the international community by the chosen country or as vote trading for political or financial favours. Kuziemko and Werker (2006) have intensively analysed these reasons for the period from 1946 to 2001 for a group of 83 developing countries and have found that some countries served during uneventful years while others did so during debates about key resolutions, i.e. when the vote of the elected country was more valuable: '(...) correlation is being driven by an unobserved, secular change in a country's international influence or diplomatic savoir faire'. Further, the authors find that the amount of U.S. aid that a country receives increases sharply (by 59%) when it is elected into the UNSC and returns to previous levels upon completion of two-year term: 'the rapid return (...) suggests that aid is not due to a new-found awareness of the country's need'.

This is relevant to this study since one of the main assumptions in the instrumental variable method is the absence of a relationship between the instrument and the outcome other than through the first-stage channel (effect of instrument on the endogenous explicative variable) (Angrist and Pischke, 2008). This statement is called the *exclusion restriction* and has two parts: the first is the statement that the instrument is as good as randomly assigned (i.e., conditional on covariates, it is independent of the outcome) and the second is that the instrument should not be related to any other potential determinant of the dependent variable that remains unobserved (i.e., that the instrument is uncorrelated with the error term).

Indeed, one may think that selection into the council might be driven by the degree of development of the country – and thus by the level of poverty – so that poorer countries would tend to have a lower probability of rotating into the council. Assuming that income poverty levels have declined in the last three decades (United Nations, 2009a), average poverty during the period from 2000 to 2014 would be less likely to explain selection onto the council between 1946 and 1999. Therefore, by design, we should not have any reason to believe that the outcome might explain the instrument. At the same time, being elected as a temporary member of the UNSC should not contribute to reduce poverty levels by itself. It might influence poverty levels – and this is what this study would like to find in the reduced-form relationship – but only if the country received additional funding as a consequence of being elected and this has, in turn, contributed to a reduction in poverty in the country (i.e., that there exists a relationship between the instrument and the outcome but only through the first-stage channel).

To better understand the relationship between poverty and years spent on the UNSC, I plot

Figure 1.4.1 – Multidimensional poverty and service on the UNSC



Source: OPHI and the U.N website
Note: country abbreviations are for Niger (NER), Thailand (THA), Colombia (COL), Argentina (ARG) and Brazil (BRA).

both variables in figure 1.4.1. Most of the countries in the sample have spent less than five years on the UN security council during the period from 1946 to 1999 but they nonetheless present large differences in their levels of MPI. For instance, Niger and Thailand have both spent two years (one service) at the UNSC but Niger presents an average MPI of 62.33%, whereas Thailand's is 0.60%. Moreover, we notice that the potential negative relationship between the instrument and the outcome is particularly led by three countries: Brazil, Argentina and Colombia. All three of them are the countries that have spent the most years on the UNSC and have enjoyed low levels of multidimensional poverty in the last decade.[20] Despite not having data for multidimensional poverty for the period from 1946 to 1999, there are strong reasons to believe that the level of poverty was not the main factor leading to their selection as rotating members but, instead, they might enjoy low levels of poverty today due to an increase of funding when rotating onto the council in the past. Indeed, U.S. foreign policy in Latin America during the Cold War was largely supported by 'a modest military aid program' to fight communism in the region (Hilton, 1981). Moreover, Brazil collaborated intimately with the United States during World War I and II and this 'justified and guaranteed, in the view of Brazilian policy makers, a postwar intensification of American aid'

[20]Similar observations are drawn from the income poverty gap (at $1.90/day and $3.10/day) and UNSC relationship. Please refer to figures 1.A.3 and 1.A.4 in the Appendix.

(Hilton, 1981).[21]

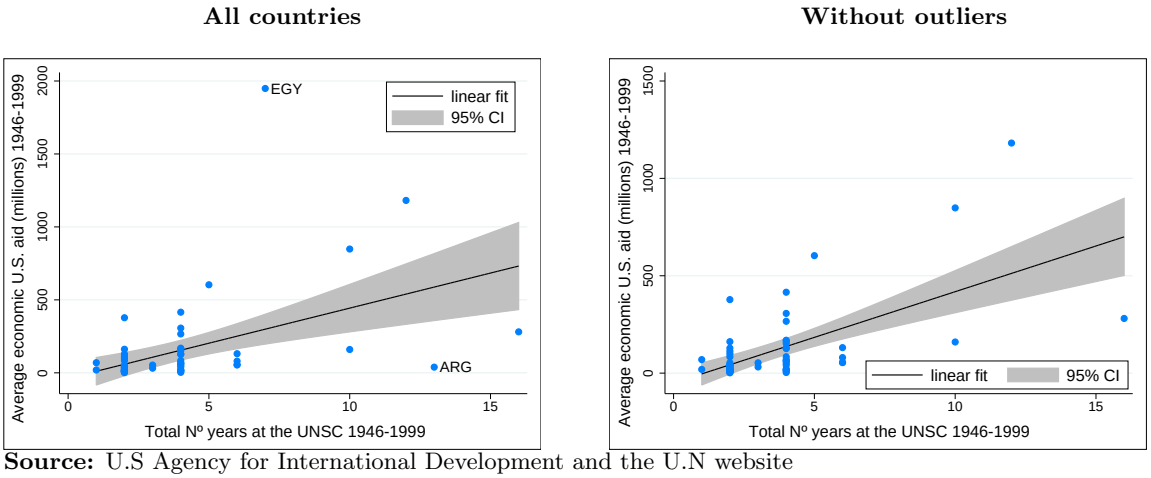
The second part of the exclusion restriction assumption (the absence of a correlation between the instrument and the error term), cannot, in general be tested (Angrist and Pischke, 2008) but can be argued by ruling out any effect caused by the omitted variables. This is tricky since estimations may exclude potential relevant determinants of poverty – in which case the information would be kept in the residual term – and, if they are potentially related to the instrument, the condition would be violated. As unobserved time-invariant characteristics that could be related to the instrument, one can point out those specific to the region where the country is located. For instance, following previous arguments, Latin America was a specific region of influence for Washington during the Cold War period and, as such, countries like Colombia, Brazil and Argentina may have had a higher probability of being elected than countries in Eastern Europe that were already under the influence of the Soviet Union. Empirically, it is possible to control for these unobservable characteristics by including regional dummy variables (cf. results section) and thus avoid a potential correlation between the error term and the instrument.

Another potential determinant of poverty that might be related to the instrument is whether the country is endowed with natural resources. Indeed, the large literature on the political economy of the resource curse provides evidence of a negative relationship between natural resource endowment, economic growth and poverty (see, for instance, Sachs and Warner (1995), Sala-i-Martin and Subramanian (2008). Moreover, resource endowment could be a strategic factor influencing votes in the UNSC. If not measured, the instrument might invalidate the exclusion restriction statement. I therefore control for this issue in the robustness checks section. Finally, poverty as a multidimensional phenomenon might be affected by unemployment, health status, educational level, and housing conditions, for instance. However, including these variables in the equation may introduce another problem of reverse causality since most of them are measured in the MPI. Further, the instrument is less likely to be related to these factors.

Moving forward, the other main assumption in the instrumental variable method is a strong correlation between the instrument and the endogenous variable of interest. Figure 1.4.2, plots the relationship between the total number of years a country has spent on the UNSC and the average amount of economic aid received from the U.S., between the years 1946 and 1999. There seems to exist a large correlation between the two variables (0.46). However, two outliers are noticed, Egypt and Argentina, which have respectively received exceptionally high and relatively low amounts of aid in relation to their number of years on the council. When controlling for these outliers, the

[21] Since the relationship between poverty levels and years on the council (reduced-form relationship) might be led by these three countries, I check for the robustness of results when controlling for Brazil and Colombia (I already control for Argentina as an outlier in the aid-poverty relationship. Justification for this is found later in this section). I find that baseline results are indeed robust. I do not present them here, but they can be provided upon request.

Figure 1.4.2 – Total number of years at the UNSC and average U.S. economic aid received



Source: U.S Agency for International Development and the U.N website
Note: country abbreviations are for Argentina (ARG) and Egypt (EGY).

correlation between the two variables increases to 0.61. The relevance of the instrument in this sense can be empirically tested in the first stage of the regression (cf. results section). The theoretical argument that assumes a close relationship between both variables is, again, supported by evidence from previous studies, such as Alesina and Dollar (2000) and Meernik et al. (1998). Whereas the former underlines that a colonial past, voting patterns in the United Nations and political alliances could be major determinants of foreign aid, the latter highlights that there was indeed a shift in the intentions of U.S. foreign aid from strategic and diplomatic needs to development promotion after the Cold War (cf. section 1.2).

1.5 Empirical Strategy and Main Results

1.5.1 Empirical strategy

For country i, I estimate using Two-Stage Least-Squares (2SLS) and by Ordinary Least Squares (OLS), a cross-sectional linear model as follows:

$$y_i = \gamma_r + \alpha_1 AID_i + x_i'\zeta + \varepsilon_i, \tag{1.5.1}$$

where y_i is the average value of poverty for country i=1, ..., 64 between 2000 and 2014. AID_i is the average U.S economic aid received by the country between 1946 and 1999. The coefficient α_1 measures the association between U.S. aid and poverty – on average – which is the parameter of interest throughout the paper. I include dummy variables at the regional level, measured by the coefficient γ_r, accounting for the specific and unobserved characteristics of each region. $x_i'\zeta$ is the vector of covariates. And ε_i is the error term assumed of mean 0 and variance σ_ε^2, clustered at the

country level. AID_i is treated as endogenous and modelled as follows:

$$AID_i = \gamma_r + \delta UNSC_i + x_i'\zeta + \nu_i, \tag{1.5.2}$$

where $UNSC_i$ is the total number of years a country has spent on the UNSC between 1946 and 1999. The coefficient δ measures the average effect of an additional year on the UNSC on the average amount of aid received by the country. $x_i'\zeta$ is the vector of covariates. And ν_i is the error term assumed of mean 0 and variance σ_ν^2.

1.5.2 Main results

Table 1.5.1 – Main results of the OLS estimation

(a) Income Poverty $1.90/day

	(1) Gap	(2) H	(3) Gap	(4) H	(5) Gap	(6) H
AID	-0.013**	-0.022*	-0.030**	-0.078***	-0.015	-0.043*
	(0.005)	(0.013)	(0.012)	(0.026)	(0.012)	(0.024)
Observations	58	58	58	58	58	58
Covariates	No	No	Yes	Yes	Yes	Yes
Outliers	No	No	Yes	Yes	Yes	Yes
Regional dummies	No	No	No	No	Yes	Yes

(b) Income Poverty $3.10/day

	(7) Gap	(8) H	(9) Gap	(10) H	(11) Gap	(12) H
AID	-0.014	-0.008	-0.052***	-0.088***	-0.026	-0.040
	(0.009)	(0.017)	(0.017)	(0.028)	(0.016)	(0.026)
Observations	58	58	58	58	58	58
Covariates	No	No	Yes	Yes	Yes	Yes
Outliers	No	No	Yes	Yes	Yes	Yes
Regional dummies	No	No	No	No	Yes	Yes

(c) Multidimensional Poverty

	(13) MPI	(14) H	(15) MPI	(16) H	(17) MPI	(18) H
AID	-0.0.10**	-0.016*	-0.059***	-0.100***	-0.036***	-0.057**
	(0.005)	(0.008)	(0.016)	(0.027)	(0.012)	(0.022)
Observations	64	64	64	64	64	64
Covariates	No	No	Yes	Yes	Yes	Yes
Outliers	No	No	Yes	Yes	Yes	Yes
Regional dummies	No	No	No	No	Yes	Yes

Notes: Robust standard errors in parentheses. Covariates include per capita GDP growth, population density, trade (% GDP), per capita GDP and polity 2. Outliers for income poverty regressions are India and Pakistan (India and Pakistan are the outliers in the income poverty-AID relationship (cf. figures 1.A.1 and 1.A.2 in the Appendix). Outliers for multidimensional poverty regressions are India, Pakistan and Egypt. India, Pakistan and Egypt are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2). Regional dummies for income poverty regressions are Latin America, Europe and Asia (Africa is the reference dummy. There is no income poverty information for the Middle East economies considered in the study). Regional dummies for multidimensional poverty regressions are Latin America, Europe, the Middle East and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

Table 1.5.1 shows empirical results from OLS estimations of equation 1.5.1. Columns 1 to 12

present OLS regressions of income poverty – as measured by the poverty gap and the headcount ratio for $1.90/day and $3.10/day – for U.S. aid. Columns 13 to 18 show results from multidimensional poverty regressions – as measured by the MPI and the headcount ratio.

The two first columns of each measure report simple correlations, the third and fourth show results when adding controls for outliers and covariates and the last two report results when adding controls for specific regional characteristics. Comparing simple correlations for both income and multidimensional poverty measures, one observes that an increase in U.S. aid seems to be significantly related to a reduction in multidimensional poverty and severe income poverty (columns 1 to 2 and 13 to 14, respectively). This is true when introducing the set of covariates and outliers (columns 3 to 4 and 15 to 16, respectively). Columns 9 and 10 for the poverty gap and the headcount ratio at $3.10/day also report a significant relationship between aid and income poverty when accounting for outliers and covariates. However, when unobservable characteristics at the regional level are taken into account, the relationship seems to remain more significant when poverty is measured from a multidimensional rather than an income perspective. Indeed, when comparing results from columns 5 to 6, 11 to 12 and 17 to 18, aid is – on average – more significantly related to a decrease in the MPI and the multidimensional headcount ratio (columns 17 and 18) than to a decrease in income poverty, where only a negative relationship for the severe income poverty gap, significant at the 10% confidence level, is observed.

In order to control for potential reverse causality and endogeneity issues between poverty variables and aid, I run 2SLS regressions of equation 1.5.1. Results are presented in table 1.5.2. As previously stated, I use the total number of years a country has spent on the UNSC as an instrument for U.S. aid. Columns 1, 3, 5, 7, 9 and 11 show first-stage results. The UNSC coefficient is positive and statistically significant at the 1% confidence level in all of the specifications, suggesting that rotation onto the council is related to a higher amount of aid received by a country on average. The relevance of the instrument is tested in the first-stage regression. As a rule of thumb, Stock et al. (2002) and Angrist and Pischke (2008) suggest that the F-statistic of a joint test determining whether the excluded instrument is significantly different from zero should be bigger than 10 in the case of a single endogenous regressor. In the case of a single instrument and a single endogenous regressor, this implies that the t-value for the instrument should be bigger than 3.2 or the corresponding p-value below 0.002. Results in table 1.5.2 (t-test in brackets and F-test in the last row) show that these requirements are indeed satisfied for both multidimensional poverty and income poverty.[22]

[22]Following Angrist and Pischke (2008), the J-test of overidentifying restrictions that is used to check for the exogeneity of the instrument used, it is only performed when the estimated model is overidentified. That is, when there are more instruments than instrumented variables. Since in the current study there is only one instrument used to explain one right-hand side variable, the exogeneity of the intrument can only be justified on logical and substantive grounds as it is done in section 4 of this article.

Comparing OLS results in columns 5 and 11 of table 1.5.1 with 2SLS results in columns 4 and 8 of table 1.5.2, it is observed that α_1 is no longer significant for the income poverty gap at \$1.90/day when accounting for potential endogeneity of the aid variable and the remaining coefficients do not differ in size across estimation methods. Nonetheless, the 2SLS estimated coefficient of the multidimensional poverty regression (column 12) is larger and more significant than the OLS regression (column 17).

First-stage results in column 11 of table 1.5.2 suggest that one additional year on the UNSC during 1946 to 1999 is related to a higher amount of economic aid received from the United States – almost US\$21 million, on average, among the 64 countries. In turn, U.S. aid seems to be associated with an MPI that is 0.08 percentage points lower but does not seem to be significantly related to a lower income poverty gap or a lower headcount ratio – at either \$1.90/day or \$3.10/day.[23] Because of potential reverse causality and endogeneity issues between poverty and aid, 2SLS results are preferred to OLS. I therefore proceed with 2SLS estimations in the remainder of the article.

Table 1.5.3 reports detailed 2SLS estimation results from equation 1.5.1 on the MPI. I go step by step, adding control variables and showing in each column first-stage statistics. In the last two rows of the table, one can observe that the F-test of excluded instruments and the t-test of the UNSC coefficient are larger than 10 and 3.2 in almost all the specifications. This already informs that the instrument passes the required statistical test for the validity of its correlation with the aid variable. Moreover, the coefficient of interest from equation 1.5.1, α_1, remains highly significant and negative in all columns, independent of the additional control variable and the specific regional characteristics, suggesting a close average relationship between a higher amount of aid received by the country over the period from 1946 to 1999 and a lower MPI between 2000 and 2014. Columns 11 and 12 from table 1.5.2 and columns 7 and 8 from table 1.5.3 are the same and report baseline results from regressions on multidimensional poverty.

As previously noted, an additional year on the UNSC during 1946 to 1999 seems to be related to a US\$21 million increase – on average – in the amount of aid received from the United States among the 64 countries of the study. At the same time, an additional US\$1 million (2014 US\$) per year – US\$53 million from 1946 to 1999 – is associated with a 0.08 percentage points lower MPI – on average. Since the average amount of aid received over the period was US\$143.7 million (cf. table 1.5.3 and 1.3.1), it is possible to say that a country received roughly 14.6% more aid from the U.S. on average during the period 1946–1999 when rotating at least one additional year onto the

[23] Results are robust when controlling for Brazil and Colombia as potential leaders of the UNSC-poverty relationship. I do this in order to check that the exclusion restriction assumption holds (i.e., that the only relationship that exists between the instrument and the outcome is through the first-stage channel [UNSC-aid relationship]) (cf. section 1.4). Results can be provided upon request.

Table 1.5.2 – Main results of 2SLS estimation

(a) Income Poverty Gap $1.90/day

	(1) AID 1st stage	(2) IP 2nd stage	(3) AID 1st stage	(4) IP 2nd stage
UNSC	19.098***		18.507***	
	(3.686)		(3.028)	
	[5.18]		[6.11]	
AID		-0.046**		-0.023
		(0.023)		(0.020)
Observations	58	58	58	58
Regional dummies	No	No	Yes	Yes
F-test	26.84	–	37.34	–

(b) Income Poverty Gap $3.10/day

	(5) AID 1st stage	(6) IP 2nd stage	(7) AID 1st stage	(8) IP 2nd stage
UNSC	19.098***		18.507***	
	(3.686)		(3.028)	
	[5.18]		[6.11]	
AID		-0.080**		-0.038
		(0.036)		(0.030)
Observations	58	58	58	58
Regional dummies	No	No	Yes	Yes
F-test	26.84	–	37.34	–

(c) Multidimensional Poverty Index

	(9) AID 1st stage	(10) MPI 2nd stage	(11) AID 1st stage	(12) MPI 2nd stage
UNSC	20.981***		20.314***	
	(4.293)		(3.543)	
	[4.89]		[5.73]	
AID		-0.128***		-0.083***
		(0.036)		(0.032)
Observations	64	64	64	64
Regional dummies	No	No	Yes	Yes
F-test	23.88	–	32.88	–

Notes: Robust standard errors in parentheses. T-values in brackets. F-test is the first-stage test of excluded instruments. Covariates and outliers are included in all the regressions. Covariates include per capita GDP growth, population density, trade (% GDP), per capita GDP and polity 2. Outliers for income poverty regressions are India, Pakistan and Argentina. India and Pakistan are the outliers in the income poverty-AID relationship (cf. figure 1.A.1 and 1.A.2 in the Appendix); Argentina is the outlier in the UNSC-AID relationship (cf. figure 1.4.2). Outliers for multidimensional poverty regressions are India, Pakistan, Egypt and Argentina (India, Pakistan and Egypt are the outliers in the income poverty-AID relationship (cf. figure 1.3.2); Argentina and Egypt are the outliers in the UNSC-AID relationship (cf. figure 1.4.2). Regional dummies for income poverty regressions are Latin America, Europe and Asia (Africa is the reference dummy. There is no income poverty information for the Middle East economies considered in the study). Regional dummies for multidimensional poverty regressions are Latin America, Europe, the Middle East and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

Table 1.5.3 – Step-by-step 2SLS estimation for MPI

	(1) 2nd stage	(2) 2nd stage	(3) 2nd stage	(4) 2nd stage	(5) 2nd stage	(6) 2nd stage	Baseline results (7) 2nd stage
AID	-0.126***	-0.113***	-0.100***	-0.186***	-0.146***	-0.128***	-0.083***
	(0.037)	(0.035)	(0.034)	(0.055)	(0.048)	(0.036)	(0.032)
Polity 2		-1.194***	-1.218***	-0.694	-0.082	-0.386	-0.003
		(0.443)	(0.398)	(0.660)	(0.619)	(0.568)	(0.301)
Growth			-1.940	-1.935*	-1.013	-1.310	-0.799
			(1.192)	(1.105)	(1.157)	(1.150)	(1.181)
Trade				-0.387***	-0.264***	-0.235***	-0.199***
				(0.139)	(0.089)	(0.076)	(0.057)
Pc GDP					-0.003***	-0.003***	-0.002**
					(0.001)	(0.001)	(0.001)
Population						0.027	0.018
						(0.019)	(0.015)
Observations	64	64	64	64	64	64	64
Regional dummies	NO	NO	NO	NO	NO	NO	YES
MPI mean	19.5	19.5	19.5	19.5	19.5	19.5	19.5
AID mean	143.7	143.7	143.7	143.7	143.7	143.7	143.7
F-test	18.91	17.59	16.78	8.84	11.96	23.88	32.88
T-test	4.35	4.19	4.10	2.97	3.46	4.89	5.73

Notes: Robust standard errors in parentheses. Growth stands for per capita GDP growth, trade is as % of GDP and population stands for population density. Outliers are included in all regressions. F-test is the first-stage test of excluded instruments and T-test is from the UNSC variable. Outliers are India, Pakistan, Egypt and Argentina. India, Pakistan and Egypt are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2); Argentina and Egypt are the outliers in the UNSC-AID relationship (cf. figure 1.4.2). Regional dummies are Latin America, Europe, the Middle East and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

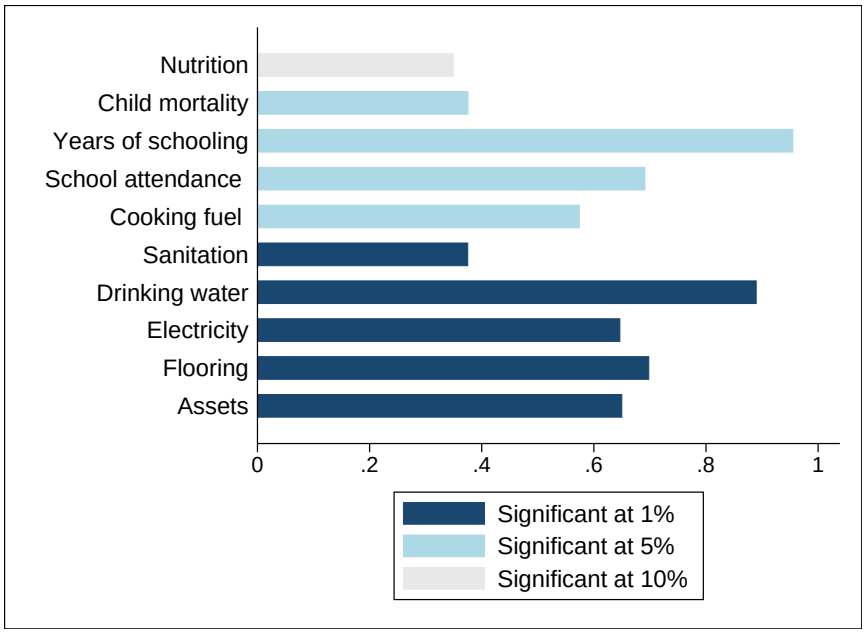
council.[24] The elasticity of poverty to aid can be obtained as follows:

$$\eta^{P}_{AID} = \alpha_1 \frac{\overline{AID}}{\overline{P}}, \tag{1.5.3}$$

where η^{P}_{AID} is the elasticity of poverty – as measured by the different specifications – to aid; α_1 is the estimated coefficient of the aid variable; $\overline{AID}$ is the average amount of aid received from the U.S. among the sample of 64 countries between the period 1946–1999; and $\overline{P}$ is the average poverty value among the sample of 64 countries between 2000 and 2014. Considering the average amount of aid and the average value of MPI (cf. table 1.5.3 and 1.3.1), the elasticity of MPI to U.S. aid is 0.61, meaning that a 1% increase in the average amount of aid received from the U.S. over the period 1946–1999 is associated – on average – with a 0.61% reduction in the MPI. This suggests that poverty reduction does not move strictly in tandem with aid but only to a lesser extent.

[24] The relationship in percentages is calculated by dividing the estimated coefficient by the mean of the outcome variable.

Figure 1.5.1 – Size of MPI elasticities to aid: decomposition by indicator



Note: Author's calculations.

I am then interested in analysing the decomposed relationship between U.S. aid and each indicator considered in the MPI. For this purpose, I run previous regressions of equation 1.5.1, but I replace the global poverty measures by each indicator (years of schooling, nutrition, drinking water, etc.) as dependent variables. Results from 2SLS estimations are reported in table 1.5.4 and figure 1.5.1 represents the size of the elasticity of each indicator to aid, calculated following equation 1.5.3.

It is observed that aid is significantly related to all the indicators included in the MPI. The largest elasticity relates to the dimension on education, where a 1% increase in average aid received is associated with a 0.95% and 0.69% reduction in the percentage of multidimensionally poor people deprived in years of schooling and school attendance, respectively.

The second largest elasticity concerns the dimension of living standards, which ranges from the highest on drinking water (0.89) to the lowest on sanitation (0.38). On average among the sample, a 1% increase in the average amount of aid received from the U.S. over the period 1946–1999 is associated with a reduction of 0.64%, 0.36% and 0.82% in the percentage of multidimensionally poor people deprived in living standards, health and education, on average, respectively.

Table 1.5.4 – Main results for MPI indicators (2SLS estimation)

	Education		Health		Living Standard					
	(1) Schooling	(2) Attendance	(3) Mortality	(4) Nutrition	(5) Electricity	(6) Water	(7) Sanitation	(8) Flooring	(9) Fuel	(10) Assets
AID	-0.103**	-0.088**	-0.052**	-0.035*	-0.130***	-0.077***	-0.117***	-0.119***	-0.137**	-0.090***
	(0.043)	(0.042)	(0.026)	(0.019)	(0.050)	(0.027)	(0.04)	(0.044)	(0.058)	(0.034)
Observations	64	58	61	60	63	64	64	63	62	64
Outcome mean	15.5	18.3	19.9	14.4	28.9	29.5	18.9	24.5	34.3	19.9
AID mean	143.7	143.7	143.7	143.7	143.7	143.7	143.7	143.7	143.7	143.7
F-test	32.88	25.80	34.86	26.30	34.25	32.88	32.88	33.36	43.74	32.88
T-test	5.73	5.08	5.90	5.13	5.85	5.73	5.73	5.78	6.61	5.73

Notes: Robust standard errors in parentheses. Covariates, regional dummies and outliers are included in all the regressions. F-test is the first-stage test of excluded instruments and T-test is from the UNSC variable. Covariates include per capita GDP growth, population density, trade (% GDP), per capita GDP and polity 2. Outliers are India, Pakistan, Egypt and Argentina. India, Pakistan and Egypt are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2); Argentina and Egypt are the outliers in the UNSC-AID relationship (cf. figure 1.4.2). Regional dummies are Latin America, Europe, the Middle East and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

1.6 Robustness Checks

In order to confirm or disprove the stability of the coefficients observed so far, I challenge the estimations results using three robustness checks. The first considers alternative measures of institutional quality; the second one includes the share of U.S. aid received – as a percentage of total aid received – and government consumption as additional controls in a 2SLS estimation of equation 1.5.1; and the third one controls for resource endowment of the country during the period 1960 and 1999.

1.6.1 Alternative proxies of institutional quality

Previous studies on aid have used different measures of institutional quality. For instance, Kuziemko and Werker (2006) and Kosack (2003) use the measure of Polity 2, which has the advantage of being available since 1946. Alternative measures such as political rights and civil liberties from the Freedom in the World survey (Puddington and Roylance, 2016) have been used by Galiani et al. (2017), Lensink and White (2001) and Alesina and Dollar (2000). And the measure of ethnic fractionalization appears in studies such as Dalgaard et al. (2004), Hansen and Tarp (2001) and Burnside and Dollar (2000). Apart from ethnic fractionalization, Alesina et al. (2003) have created measures of language and religious fractionalization. Correlations between these three variables range from 0.3 to 0.6.[25] I have decided to consider all three in this section in order to control for the potential role played by existing population divisions.

I proceed by replacing the polity 2 variable with alternative measures of institutional quality in the 2SLS estimations of equation 1.5.1. Table 1.6.1 reports baseline results for MPI in column 1 and robustness in columns 2 to 6. The coefficient of aid is statistically significant and remains quite stable in all the specifications, although significance is reduced in the last three columns. This suggest that aid is significantly associated with a decrease in the MPI on average, independently of the level of democracy (polity 2), the level of freedom in the country (political Rights and civil liberties) and the type of fractionalization (ethnic, language and religious) characterising the population.[26] Moreover, the first-stage results reported in the last two rows of table 1.6.1 show that the instrument still passes the relevant statistical tests (F-test of excluded instruments and t-test of UNSC).

1.6.2 Additional controls

Two potential additional determinants of poverty that might be correlated with selection onto the UNSC are the amount of aid received by other donors and government expenditure. Indeed, one may think that an increase in funds received from the U.S. due to rotation onto the council can

[25] Detailed correlations for these alternative measures of institutional quality can be provided upon request.

[26] Results are also robust when regressing the 10 indicators considered in the MPI and the income poverty measures on alternative proxies of institutional quality. They can be provided upon request.

Table 1.6.1 – Robustness checks: alternative measures of institutional quality

	Baseline results	Robustness of baseline results				
	(1) MPI	(2) MPI	(3) MPI	(4) MPI	(5) MPI	(6) MPI
AID	-0.083***	-0.083***	-0.083***	-0.086**	-0.077**	-0.082**
	(0.032)	(0.032)	(0.032)	(0.034)	(0.031)	(0.033)
Polity 2	-0.003					
	(0.301)					
Political Rights		0.483				
		(1.270)				
Civil Liberties			0.313			
			(1.554)			
Ethnic				11.308		
				(7.934)		
Religious					-6.951	
					(7.286)	
Language						6.077
						(6.198)
Observations	64	64	64	63	64	63
F-test	32.88	33.32	34.62	43.94	35.16	34.77
T-test	5.73	5.77	5.88	6.63	5.93	5.90

Notes: Robust standard errors in parentheses. Coefficients are estimated by 2SLS. Ethnic, religious and language stand for the 3 different types of fractionalisations. F-test is the first-stage test of excluded instruments and T-test is from the UNSC variable. Covariates, regional dummies and outliers are included in all the regressions. Covariates include per capita GDP growth, population density, trade (% GDP) and per capita GDP. Outliers are India, Pakistan, Egypt and Argentina. India, Pakistan and Egypt are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2); Argentina and Egypt are the outliers in the UNSC-AID relationship (cf. figure 1.4.2). Regional dummies are included in all the regressions and include Latin America, Europe, the Middle East and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

influence the amount received from other donors. I control for this by introducing in equation 1.5.1 the ratio of U.S. economic aid over the total (gross loans and grants) received from DAC donors, averaged over the period 1960–1999.

Concerning the second one, previous studies such as Celasun and Walliser (2008), Hudson (2015) and Bulíř and Hamann (2003, 2008) have pointed out that volatility of aid and government expenditure go hand in hand, growing with the degree of aid dependency. Authors have found that shortfalls in aid are most frequently followed by reductions in government spending and that the most volatile sectors are those linked to government, industry and program assistance (Hudson, 2015). Moreover, Celasun and Walliser (2008) found that when aid disbursements are at least 1% higher than what was expected for budget aid (relative to GDP), government consumption is significantly boosted, whereas aid shortfalls lead to cuts in investment spending. To control for these potential effects, I also introduce in equation 1.5.1 the average of government consumption (as % GDP) over the period 1960–1999. I then proceed to estimate equation 1.5.1 for the income poverty gap at $1.90/day and $3.10/day as well as for the MPI, replicating baseline estimations from table 1.5.2 (columns 3–4, 7–8 and 11–12) but with additional controls. Results are reported in table 1.6.2.

Table 1.6.2 – Robustness checks: additional controls (share US aid & government consumption)

	IP Gap $1.90/day			IP Gap $3.10/day			MPI		
	(1) IP	(2) IP	(3) IP	(4) IP	(5) IP	(6) IP	(7) MPI	(8) MPI	(9) MPI
AID	-0.015	-0.011	0.008	-0.025	-0.020	0.009	-0.070**	-0.071**	-0.055*
	(0.022)	(0.019)	(0.020)	(0.032)	(0.028)	(0.028)	(0.033)	(0.031)	(0.032)
Gov. Cons.	-0.852***		-1.155***	-1.219***		-1.665***	-0.800**		-0.857*
	(0.247)		(0.313)	(0.296)		(0.386)	(0.397)		(0.498)
Share US aid		-0.085	-0.204**		-0.134	-0.313***		0.006	-0.070
		(0.109)	(0.086)		(0.159)	(0.117)		(0.126)	(0.114)
Observations	57	54	53	57	54	53	63	60	59
F-test	31.72	32.98	29.61	31.72	32.98	29.61	29.48	34.08	32.59
T-test	5.63	5.74	5.44	5.63	5.74	5.44	5.43	5.84	5.71

Notes: Robust standard in parentheses. Coefficients are estimated by 2SLS. IP stands for income poverty. F-test is the first-stage test of excluded instruments and T-test is from the UNSC variable. Gov. Cons. stands for government consumption (as % GDP) and the share of US aid is as % of the total aid received. Covariates, outliers and regional dummies are included in all the regressions. Covariates include per capita GDP growth, population density, trade (% GDP), per capita GDP and polity 2. Outliers for income poverty regressions are India, Pakistan and Argentina. India and Pakistan are the outliers in the income poverty-AID relationship (cf. figure 1.A.1 and 1.A.2 in the Appendix); Argentina is the outlier in the UNSC-AID relationship (cf. figure 1.4.2). Outliers for multidimensional poverty regressions are India, Pakistan, Egypt and Argentina. India, Pakistan and Egypt are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2); Argentina and Egypt are the outliers in the UNSC-AID relationship (cf. figure 1.4.2). Regional dummies for income poverty regressions are Latin America, Europe and Asia (Africa is the reference dummy. There is no income poverty information for the Middle East economies considered in the study). Regional dummies for multidimensional poverty regressions are Latin America, Europe, the Middle East and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

Three things are worth noting. First, columns 1 to 6 confirm that the relationship between U.S. aid and income poverty remains close to zero and non-significant, independent of additional controls. Second, independent of additional controls, higher aid is associated with a lower MPI – although when simultaneously adding both variables the size and the significance of α_1 are lower. And third, that government consumption seems to be significantly associated with a decrease in both the income gap and in the MPI, whereas the ratio of U.S. aid received over the total amount is related to the former.[27]

1.6.3 Natural resource endowment

The last robustness check that is carried out in order to confirm or disprove the stability of the coefficients observed so far is a control on the endowment of natural resources by a country during the period 1970–1999. I do this to control for potential factors that may be correlated simultaneously with the instrument and the outcome in order to ensure the validity of the exclusion restriction. As noted in the instrument section, countries endowed with natural resources tend to have lower levels of development and they can also be subject to international strategic interests, influencing

[27] Results are robust when replicating regressions on the 10 indicators considered in the MPI (except for deprivations in solid fuel and nutrition). They can be provided upon request.

Table 1.6.3 – Robustness checks: endowment with natural resources

	Gap $1.90/day	Gap $3.10/day	Education			Health			Living Standards				
	(1) IP	(2) IP	(3) MPI	(4) Schooling	(5) Attedance	(6) Mortality	(7) Nutrition	(8) Electricity	(9) Water	(10) Sanitation	(11) Flooring	(12) Fuel	(13) Assets
AID	-0.032	-0.051	-0.086**	-0.103**	-0.088**	–0.056**	-0.037*	-0.134**	-0.082***	-0.121***	-0.124***	-0.141**	-0.094**
	(0.020)	(0.031)	(0.034)	(0.043)	(0.043)	(0.027)	(0.020)	(0.054)	(0.028)	(0.046)	(0.047)	(0.061)	(0.037)
Dummy RR	8.524***	11.938***	5.886**	0.958	2.674	9.257***	3.430*	10.465**	9.036***	7.552*	10.500**	7.885	8.970**
	(2.859)	(3.581)	(2.847)	(3.810)	(3.638)	(2.717)	(2.031)	(4.861)	(3.036)	(4.459)	(4.877)	(5.312)	(3.707)
Observations	58	58	64	64	58	61	60	63	64	64	64	62	64
Outcome mean	10.8	21.3	19.5	15.5	18.3	19.9	14.4	28.9	29.5	18.9	24.5	34.3	19.9
AID mean	143.7	143.7	143.7	143.7	143.7	143.7	143.7	143.7	143.7	143.7	143.7	143.7	143.7
F-test	33.65	33.65	34.09	34.09	29.97	36.08	28.92	35.39	34.09	34.09	34.43	57.08	34.09
T-test	5.80	5.80	5.84	5.84	5.47	6.01	5.38	5.95	5.84	5.84	5.87	7.56	5.84

Notes: Robust standard errors in parentheses. Coefficients are estimated by 2SLS. F-test is the first-stage test of excluded instruments and T-test is from the UNSC variable. Covariates, outliers and regional dummies are included in all the regressions. Covariates include per capita GDP growth, population density, trade (% GDP), per capita GDP and polity 2. Outliers for income poverty regressions are India, Pakistan and Argentina. India and Pakistan are the outliers in the income poverty-AID relationship (cf. figure 1.A.1 and 1.A.2 in the Appendix); Argentina is the outlier in the UNSC-AID relationship (cf. figure 1.4.2). Outliers for multidimensional poverty regressions are India, Pakistan, Egypt and Argentina. India, Pakistan and Egypt are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2); Argentina and Egypt are the outliers in the UNSC-AID relationship (cf. figure 1.4.2). Regional dummies for income poverty regressions are Latin America, Europe and Asia (Africa is the reference dummy. There is no income poverty information for the Middle East economies considered in the study). Regional dummies for multidimensional poverty regressions are Latin America, Europe, the Middle East and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

votes in the UNSC.

To control for this, I include in equation 1.5.1 a dummy variable equal to one if the country's average total natural resource rents to GDP (in %) over the period 1970–1999 is higher than 10%, and zero otherwise (Collier, 2008).[28] Natural resource rents correspond to the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. Following Collier (2008), I have used these rents instead of resource exports because primary commodity exports do not take into account the cost of production of natural resources, which are much lower, for instance, in oil than in coffee production. They are a 'poor guide to how valuable the resources really are'.[29] I thus classify 18 countries as resource-rich – 13 from Africa, 1 from Asia, 2 from Latin America and 2 from the Middle East. Then, I run 2SLS estimations of equation 1.5.1 for income poverty as measured by the \$1.90/day and \$3.10/day gap, for the MPI and the 10 indicators considered in the index. Table 1.6.3 reports results.

Two conceptual observations can be highlighted. The first is that resource-rich countries seem to present higher significant levels of both income and multidimensional poverty. One can observe that the coefficient of the dummy variable is large and statistically significant in almost all the specifications. The second is that, even when accounting for this characteristic, baseline results remain robust. Indeed, the coefficients of aid and their (in)significance are quite stable, confirming that aid is associated with lower multidimensional poverty but not with lower income poverty.

Calculating elasticities for MPI and the indicators following equation 1.5.3, I find that a 1% increase in the average amount of aid received from the U.S. over the period 1946–1999 is associated – on average – with a 0.63% reduction in the MPI and with a 0.66%, 0.39% and 0.82% in the percentage of multidimensionally poor people deprived in living standards, health and education, on average, respectively. This is indeed pretty close to the results presented in the previous section – 0.61%, 0.64%, 0.36% and 0.82%, respectively – suggesting a robust, significant relationship between aid and multidimensional poverty alleviation.

1.7 Sensitivity Checks

In this section, I present three sensitivity checks in order to test for the robustness of main results when adjusting for multiple inference concerns, for sampling differences and when accounting for time trends.

[28] I have also considered a threshold of average natural resource rents equal to or higher than 20% of GDP and also the average amount of resource rents (as % of GDP) over the period 1970–1999. Results remain robust in all specifications. They can be provided upon request.

[29] '(...) \$1 million in oil exports generates a bigger surplus if it is coming from an easy-to-exploit onshore location than if it is deep offshore, and if the price per barrel is \$60 rather than \$10'. (Collier, 2008).

When conducting analysis on multiple different outcomes, such as the one developed in this article, probability of falsely concluding that a tested hypothesis is rejected – i.e., committing a type I error –, increases with the number of outcomes that are being compared (Wright, 1992). For instance, when comparing three estimated coefficients in regressions of income poverty at $\$1.90/day$, at $\$3.10/day$, and of multidimensional poverty on aid, if the significance level (or the type I error rate) is set to be 0.05, the probability that one of these three coefficients is statistically different from zero increases from 5% to $[1-(1-0.05)^3 = 14.2\%]$.[30]

Following Wright (1992), a way to solve this multiple inference problem is to account for the multiple tests that are being conducted by reporting the adjusted P-values. If a P-value is defined as the smallest level of significance from which the null hypothesis can be rejected, an adjusted P-value of a particular hypothesis within a group of hypotheses, would be the smallest overall significance level from which this particular hypothesis could be rejected (Wright, 1992). Then, the adjusted P-value, as the unadjusted one, can be compared with any significance level, so that if the adjusted P-value is lower than the chosen significance level, the tested hypothesis would be rejected.

The most restrictive correction is the Bonferroni procedure. If there are n hypotheses to test and a significance level of α, being p_i the unadjusted P-value for testing hyposthesis H_i, this hypothesis would be rejected if np_i is equal or lower than α. That is, the Bonferroni correction uses equal allocation of the significance level among the hypotheses to be tested. For instance, in the previous example of three outcomes and a significance level of 5%, each estimated coefficient would be considered statistically significant if $3p_i$ is lower than 0.05.

Nontheless, the Bonferroni procedure assumes that outcomes are independent from each other. In this sense, when analysing the association of aid on each of the indicators included in the MPI, for instance, one would be assuming that the relation of aid with schooling is independent of the association of aid with school attendance. Since this is unlikely to happen in the current context of study, Wright (1992) suggests the use of two less conservative, and more powerful, procedures that are simple modifications of Bonferroni: the Holm and the Hochberg procedures. Holm's correction consists of ordering the unadjusted P-values p_i from smallest to largest and find the smallest P-value that satisfies $(n-i+1)p_i$ equal or lower than α – instead of npi equal or lower than α, as in Bonferroni's. The hypothesis H_i attached to this P-value and all those with smaller P-values would be rejected. In other words, the test of the hypotheses is done sequentially, beggining with the smallest P-value p_i and the test stops when one obtains a non-significant result, so that all the hypotheses that remain untested cannot be rejected. The Hochberg procedure also orders the unadjusted P-values but from the largest to the smallest, stopping when an hypothesis is rejected and declaring the rest of untested hypotheses as also rejected. This procedure has the characteristic

[30] Method Guides on "10 things you need to know about multiple comparisons" from Evidence in Governance and Politics (http://www.egap.org).

that the adjusted P-values cannot be larger than one, so that there is no adjusted P-value that can be larger than the largest unadjusted P-value.

Table 1.7.1 – Sensitivity checks: main results of the 2SLS estimation with adjusted p-values

Outcome	Estimated aid coefficient	SE	Unadjusted p-value	Bonferroni (simple)	Holm	Hochberg
(a) Income Poverty $1.90/day						
Gap	-0.023	0.020	0.264	0.792	0.410	0.264
(b) Income Poverty $3.10/day						
Gap	-0.038	0.030	0.205	0.615	0.410	0.264
(c) Multidimensional Poverty						
MPI	-0.083	0.032	0.009 ***	0.027 **	0.027 **	0.027 **

Notes: results correspond to main results from 2SLS estimations that appear in columns (4), (8) and (12) of Table 2. Adjusted p-values for a significance level of 10%. *** p<0.01, ** p<0.05, * p<0.1.

Consequently, I proceed to test the sensitiveness of the main results found throughout the analysis – i.e., those found in table 1.5.1, table 1.5.2 and table 1.5.4 – by applying the three different corrections on the obtained P-values. Table 1.7.1 and table 1.C.1 in the Appendix, show results from 2SLS estimations and table 1.C.2 in Appendix presents results from OLS estimations.[31]

In table 1.7.1, I present the adjusted P-values obtained from the Bonferroni, Holm and Hochberg procedures of estimations of income poverty at $\$1.90/day$, at $\$3.10/day$, and of multidimensional poverty (MPI) on aid, controlling for covariates, outliers and regional time-invariant characteristics. Despite the adjusted P-value is slightly larger that the unadjusted one in the three corrections, the association between higher amounts of aid and lower levels of multidimensional poverty index is still significant at the 5% confidence level, whereas results for income poverty are still not significant at any confidence level. Table 1.C.1 in the Appendix shows adjusted P-values for the ten indicators included in the MPI. Following the Bonferroni procedure, only five indicators seem to be significantly associated with aid – indicators in the living standards dimension. Nonetheless, when relaxing the contraining assumptions of Bonferroni's correction, Holm's and Hochberg's indicates that almost all the coefficients that are statistically significant by their unadjusted P-values are also statistically significant at the 10% and 5% confidence level, respectively.

Concerning P-value adjustement in OLS estimations, presented in table 1.C.2 in the Appendix, it is noted that results concerning multidimensional poverty are still robust, whereas the relationship between higher amounts of aid and lower incidence of income poverty at $\$1.90/day$ does not seem

[31]The three procedures have also been applied to the remaining tables presented in the analysis. Results can be provided upon demand.

to be significant when adjusting the P-values. This further supports results found throughout the article.

Table 1.7.2 – Sensitivity checks: main results for MPI for 58 countries (2SLS estimation)

	(1) AID 1st stage	(2) MPI 2nd stage	(3) AID 1st stage	(4) MPI 2nd stage
UNSC	19.098***		18.507***	
	(3.686)		(3.028)	
	[5.18]		[6.11]	
AID		-0.138***		-0.094**
		(0.044)		(0.038)
Observations	58	58	58	58
Regional dummies	No	No	Yes	Yes
F-test	26.84	–	37.34	–

Notes: Robust standard errors in parentheses. T-values in brackets. Covariates and outliers are included in all the regressions. F-test is the first-stage test of excluded instruments. Covariates include per capita GDP growth, population density, trade (% GDP), per capita GDP and polity 2. Outliers are India, Pakistan and Argentina (India and Pakistan are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2); Argentina is the outlier in the UNSC-AID relationship (cf. figure 1.4.2. There is no information for Egypt in the sample of 58 countries). Regional dummies are Latin America, Europe and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

The second sensitivity check that I perform is to control for sampling differences. Indeed, inference analysis on income poverty is done for 58 countries, whereas for multidimensional poverty is done for 64 countries. One may think that differences in main results could be explained by differences among the sample of countries analysed. To solve these doubts, I run main estimations presented in table 1.5.1, table 1.5.2 and table 1.5.4 for the same 58 countries that are present in the sample of income poverty.

Table 1.7.2 and table 1.C.3 in the Appendix present 2SLS estimation results of MPI on aid and of each indicator included in the MPI on aid. Table 1.C.4 in the Appendix shows OLS results for multidimensional poverty. In table 1.7.2 it is possible to observe that main 2SLS results are robust when accounting for sampling differences. The aid coefficient is slightly larger and still significant at the 5% confidence level. Furthermore, the F-statistic of a joint test determining whether the excluded instrument is significantly different from zero is bigger than 10 and its t-value bigger than 3.2, which stand the statistic requirements suggested by Stock et al. (2002) and Angrist and Pischke (2008) of a good instrument. The coefficient for UNSC is still statistically significant at the 1% confidence level, suggesting the rotation onto the council is associated with larger amounts of US aid received, on average.

In table 1.C.3 in the Appendix, it is noted that main 2SLS results for the 10 indicators included in the MPI are also robust when adjusting the sample of analysis. Table 1.C.4 in Appendix shows similar results.

Table 1.7.3 – Sensitivity checks: main results for first measures of poverty with time dummies (2SLS estimation)

	Gap $1.90/day	Gap $3.10/day		Education		Health		Living Standards					
	(1) IP	(2) IP	(3) MPI	(4) Schooling	(5) Attedance	(6) Mortality	(7) Nutrition	(8) Electricity	(9) Water	(10) Sanitation	(11) Flooring	(12) Fuel	(13) Assets
AID	-0.028	-0.039	-0.095***	-0.115***	-0.174*	-0.087**	-0.028	-0.155***	-0.074**	-0.130***	-0.136***	-0.163***	-0.116***
	(0.023)	(0.029)	(0.027)	(0.036)	(0.093)	(0.043)	(0.019)	(0.047)	(0.031)	(0.038)	(0.048)	(0.049)	(0.034)
Observations	58	58	64	64	58	61	60	63	64	64	64	62	64
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-test	25.74	25.74	27.11	27.11	2.98	6.76	24.68	28.38	27.11	27.11	26.63	43.70	27.11
T-test	5.07	5.07	5.21	5.21	1.73	2.60	4.97	5.33	5.21	5.21	5.16	6.61	5.21

Notes: Robust standard errors in parentheses. Coefficients are estimated by 2SLS. F-test is the first-stage test of excluded instruments and T-test is from the UNSC variable.Covariates, outliers and regional dummies are included in all the regressions. Covariates include per capita GDP growth, population density, trade (% GDP), per capita GDP and polity 2. Outliers for income poverty regressions are India, Pakistan and Argentina. India and Pakistan are the outliers in the income poverty-AID relationship (cf. figure 1.A.1 and 1.A.2 in the Appendix); Argentina is the outlier in the UNSC-AID relationship (cf. figure 1.4.2). Outliers for multidimensional poverty regressions are India, Pakistan, Egypt and Argentina. India, Pakistan and Egypt are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2); Argentina and Egypt are the outliers in the UNSC-AID relationship (cf. figure 1.4.2). Regional dummies for income poverty regressions are Latin America, Europe and Asia (Africa is the reference dummy. There is no income poverty information for the Middle East economies considered in the study). Regional dummies for multidimensional poverty regressions are Latin America, Europe, the Middle East and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

The third and last sensitivity check that I carry out is to control for time trends.[32] To do this I re-estimate equation 1.5.1, for the first measure of poverty since 2000 of each country and I include binary variables for each year that level of poverty was measured.[33] By doing this, I am able to control for time specific characteristics common to all the countries whose level of poverty was measured in the same year. Table 1.7.3 presents results from 2SLS regressions for income poverty and multidimensional poverty, as well as for each indicator included in the MPI, and table 1.C.5 in the Appendix present OLS results.

Observing table 1.7.3 and table 1.C.5 in the Appendix, one can notice that main results are indeed robust to this new specification: larger average amounts of aid received from the United States during the period 1946-1999 are, on average, associated with lower levels of multidimensional poverty when these are measured right after this period is concluded and when country-specific time trends are taken into account. Meanwhile, aid does not seem to be related with lower levels of income poverty.

1.8 Why Multidimensional Poverty and not Income Poverty?

So far, results from the analysis presented in this article suggest that larger amounts of aid received are rather associated with lower levels of multidimensional poverty than with lower levels of income poverty. In this section, I discuss some points that might help understand these results.

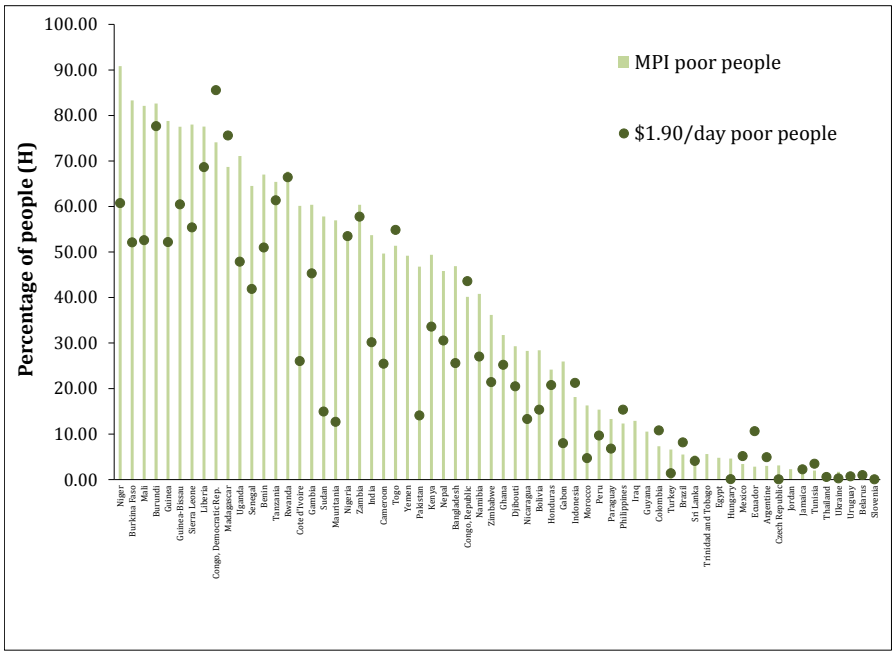
First of all, one may ask what is the relationship among these two measures. From the World Bank perspective, poverty is defined as the lack of income that an individual would need to meet her/his basic needs, based on the value of a shopping basket; whereas Oxford Poverty and Human Development Initiative (OPHI) measures poverty following Amartya Sen's capability approach, and hence defines poverty as the deprivation of basic capabilities that would enable an individual to be well educated, well nourished, live in good housing conditions or not suffer from persistent disease, for instance (Wang et al., 2016). Therefore, the first measure rather reflects the monetary aspects of poverty, while the second makes reference to non-monetary or social aspects.

Since both measures capture different concerns of the human well-being of individuals, it is reasonable to ask whether they identify the same individuals as poor. Figure 1.8.1 shows that, for the countries considered in this analysis, the ranking of countries based on poverty rates differ

[32] I also tried a different specification that considered the average of US aid received during the period 1980-1999 and 1990-1999, in order to analyse a shorter term association with levels of poverty. Nonetheless, the number of countries dropped significantly from 64 to 47 and 25, respectively, which affected the stability of results in the first case and did not enable to carry out estimation in the second one. Further research would focus on improving the current specification as to include time-varying information.

[33] The information about the years can be found in table 1.B.5 in the Appendix.

Figure 1.8.1 – Percentage of population multidimensionally poor and $1.90/day poor



Source: OPHI and World Bank
Note: a more detailed figure can be found in page 15 of OPHI (2018)

significantly according to the measure that is considered. For instance, from a multidimensional perspective, the largest share of the population who is multidimensionally poor is found in Niger, whereas when poverty is measured from and income perspective, it is the Democratic Republic of Congo. Moreover, Niger and Tanzania seem to have the same income poverty rate, while the former considers as multidimensionally poor almost 30 percentage points more people than the latter. More precisely, three in every four countries of analysis present rates of multidimensional poverty larger than income poverty, suggesting that a significant part of the population might be living above the income poverty line but be deprived in years of schooling, access to safe drinking water and has less than two durable assets, for instance.

It is noted then that both measures identify poverty differently and, thus, both measures seem to be complementary. However, the characteristics of the multidimensional poverty index enable to identify the specific social deprivations that poor people face, and thus guide policies and budget allocation by sector and region accordingly (UNDP and OPHI, 2019). Related to this matter, one may wonder whether aid disbursements could also be associated with other measures that include human development indicators such as, for instance, the Human Development Index (HDI). The Human Development Index is a composite index, measuring average achievement in three

dimensions: standards of living, proxied by gross national income (GNI) per capita; health, proxied by life expectancy; and education; proxied by the average of expected years of schooling and mean years of schooling (UNDP, 2018). One of the main differences between the MPI and the HDI is that the latter is a geometric average of the scores for the three dimension indices, whereas the former is the share of possible deprivation that poor people experience. In this sense, the MPI can be broken down by dimension and disaggregated by groups – i.e., regions, gender, age, disability –, which provides a broad analysis of poverty, enabling to identify who is poor, how poor people are and where they live (UNDP and OPHI, 2019).

Table 1.8.1 – Results for Human Development Index and its components (2SLS estimation)

		Health	Education		Living Standards
	(1)	(2)	(3)	(4)	(5)
	HDI	life expectancy	mean years schooling	expected years schooling	pc GNI
AID	0.059**	0.003	0.010	0.011**	0.005**
	(0.026)	(0.010)	(0.006)	(0.005)	(0.002)
Observations	64	64	64	64	64
F-test	25.57	32.88	32.88	32.88	25.57
T-test	5.06	5.73	5.73	5.73	5.06

Notes: Robust standard errors in parentheses. Covariates, regional dummies and outliers are included in all the regressions. F-test is the first-stage test of excluded instruments and T-test is from the UNSC variable. Covariates include per capita GDP growth, population density, trade (% GDP), polity 2 and per capita GDP (not included in columns (1) and (5)). Outliers are India, Pakistan, Egypt and Argentina. India, Pakistan and Egypt are the outliers in the HDI-AID relationship; Argentina and Egypt are the outliers in the UNSC-AID relationship (cf. figure 1.4.2). Regional dummies are Latin America, Europe, the Middle East and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

Table 1.8.1 shows 2SLS estimations of HDI and its components on US aid. Larger amounts of aid seem to be significantly associated with larger levels of human development, as measured by the HDI, through more expected years of schooling and higher income per capita. Despite larger levels of income per capita appear to be related with larger amounts of aid disbursements, the effect of increasing income on reducing poverty is, although significant, smaller when poverty is measured from a multidimensional perspective than from an monetary one (Santos et al., 2017, Wang et al., 2016). On the other hand, Wang et al. (2016) suggest that 'enhancing poor people's capabilities through education and health care will increase their productivity and income', enabling them to shoot out from both monetary and non-monetary poverty.

Finally, a feature that distinguishes multidimensional and income poverty and that could help understand the results found throughout the article is that, multidimensional poverty captures situations of deprivations that last over time, and thus reflects less volatile indicators – deprivation in years of schooling, access to safe drinking water or the presence of undernurished children in the household, for instance – than monetary poverty, which captures cyclical income fluctuations (Santos, 2019). In this sense, when observed that larger amounts of aid are associated with higher income per capita, one could think, for instance, that an illiterate poor individual might have left

income poverty but would still be deprived in years of schooling. Because income is more volatile than years of schooling, this individual could risk to fall into poverty if her/his income falls below the poverty line. However, when s/he succeeds in gaining the capability of learning to read and being educated through the provision of aid-financed public programs, s/he has more chances to shoot out from poverty and is less likely to fall again.

Consequently, alternative measures of poverty such as the Multidimensional Poverty Index could help improve the understanding of the relationship between aid and poverty, other than through economic growth, as it has been mainly analysed in previous studies.

1.9 Conclusions

In this study I have analysed the relationship between aid and poverty alleviation among 64 developing economies, accounting for reverse causality and endogeneity issues between poverty and aid by instrumenting aid with the total number of years a country has spent on the Security Council of the United Nations. Results have shown that countries received 14.6% more aid from the U.S. on average during the period 1946–1999 when rotating at least one additional year onto the council and that these flows seem to be significantly associated with lower multidimensional poverty on average over the period 2000–2014. More precisely, a 1% increase in the average amount of aid received seems to be associated with a 0.61% reduction in the MPI – on average – among the sample.

Concerning results from the 10 indicators in the MPI, I find that an average increase of 1% in U.S. aid is related to lower percentages of multidimensionally poor people deprived in education, health and living standards (0.82%, 0.36% and 0.64%, respectively). However, the relationship between aid and income poverty, as measured by the gap and headcount ratio at $1.90/day and $3.10/day, does not seem to be statistically significant. All these results are robust to a wide range of specifications and sensitivity tests.

I conclude that alternative measures of poverty, such as the Multidimensional Poverty Index, could help improve the understanding of the relationship between aid and poverty, other than through economic growth, as it has been mainly analysed in previous studies. Moreover, this might also contribute to improved targeting of aid disbursements.

Further research should focus on the impact of more precise dimensions of aid on the intended indicators over time. Enlarging the available data on poverty in order to be able to consider the temporal dimension should be a priority. Analysing the relationship between poverty and each of the different purposes of U.S. aid might also provide further insights. Further research should also focus on searching for an alternative instrument that could contribute to further test for the robustness of main results. Finally, although the current analysis is only able to give the aid-poverty

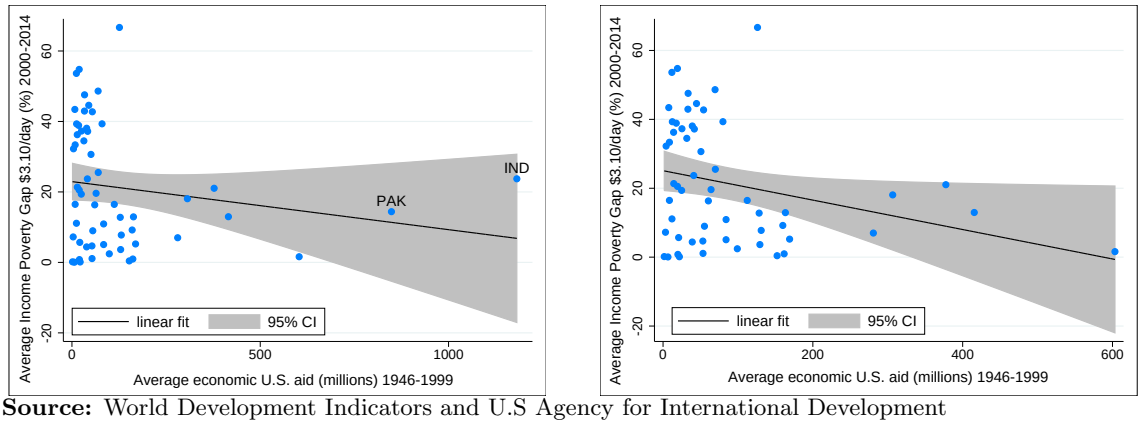
relationship an association, and not a causal, interpretation, I hope that all these results might be relevant for policy making in developing countries in order to end poverty in all its forms everywhere by 2030.

Appendix

1.A Figures

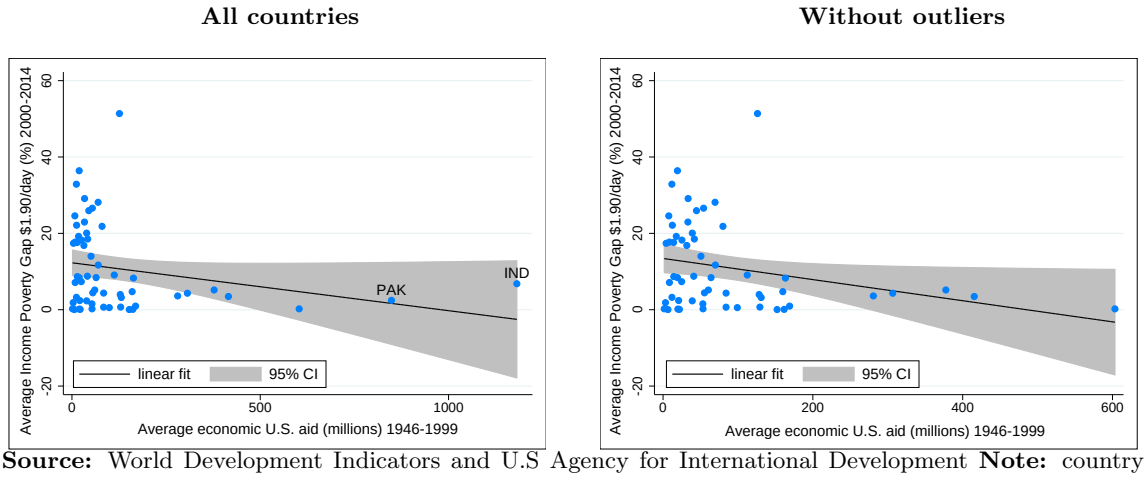
Figure 1.A.1 – U.S. economic aid and income poverty gap ($PPP3.10/day)

All countries **Without outliers**



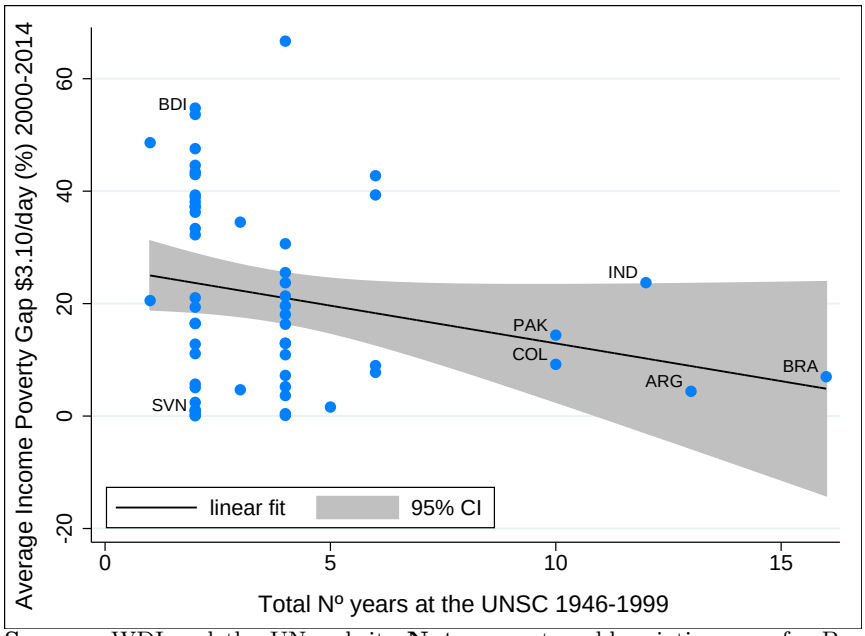
Source: World Development Indicators and U.S Agency for International Development
Note: country abbreviations are for Pakistan (PAK) and India (IND).

Figure 1.A.2 – U.S. economic aid and income poverty gap ($PPP1.90/day)



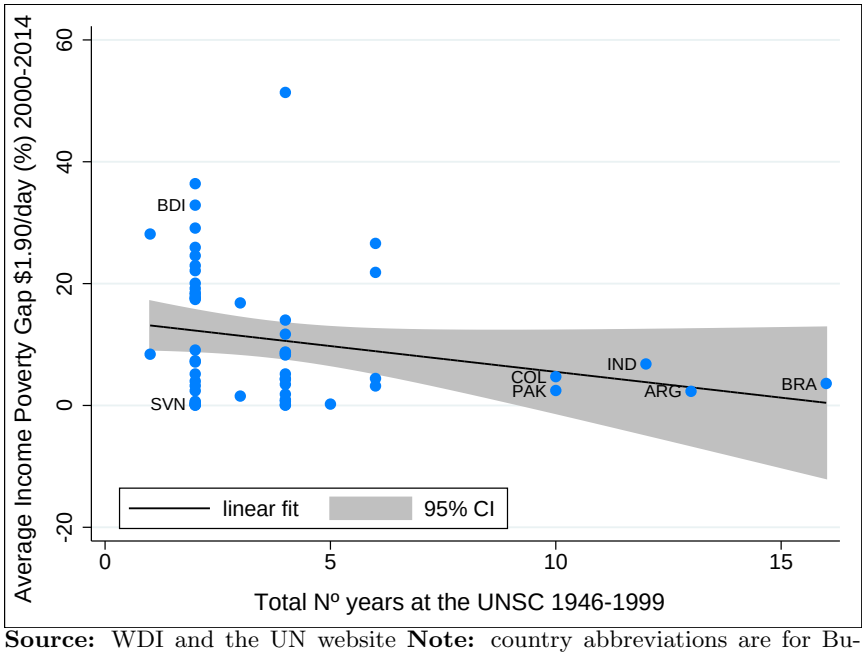
Source: World Development Indicators and U.S Agency for International Development **Note:** country abbreviations are for Pakistan (PAK) and India (IND).

Figure 1.A.3 – Income poverty gap ($PPP3.10/day) and service on the UNSC



Source: WDI and the UN website **Note:** country abbreviations are for Burundi (BDI), Slovenia (SVN), Pakistan (PAK), Colombia (COL), India (IND), Argentina (ARG) and Brazil (BRA).

Figure 1.A.4 – Income poverty gap ($PPP1.90/day) and service on the UNSC



Source: WDI and the UN website **Note:** country abbreviations are for Burundi (BDI), Slovenia (SVN), Pakistan (PAK), Colombia (COL), India (IND), Argentina (ARG) and Brazil (BRA).

1.B Descriptive Tables

Table 1.B.1 – Dimensions, indicators, and deprivations cutoffs of the MPI

Dimensions of Poverty	**Indicators**	**Deprived if:**
HEALTH	Nutrition	Any adult under 70 years of age, or any child for whom there is nutritional information is undernourished in terms of weight-for-age
	Child mortality	Any child had died in the family in the 5-year period preceeding the survey
EDUCATION	Years of schooling	No household member aged 10 or older has completed 5 years of schooling
	School attendance	School-aged child is not attending school up to the age at which he/she would complete class 8
LIVING STANDARDS	Cooking Fuel	The household cooks with dung, wood or charcoal
	Sanitation	The household's sanitation facility is not improved (according to MDG guidelines), or it is improved but shared with other households
	Drinking water	The household's does not have access to improved drinking water (according to MDG guidelines) or safe drinking water is at least 30-minute walk from home, roudtrip
	Electricity	The household has no electricity
	Flooring	The household has a dirt, sand dung, or 'other' (unspecified) type of floor
	Assets	The household does not own more than one radio, TV, telephone, bicycle, motorbike or refrigerator and does not own a car or truck

Source: Alkire et al. (2016)

Table 1.B.5 – Years at the UNSC, average U.S. aid, average multidimensional and income poverty

Country	Code	Survey Year	MPI (%) (00-14)	Survey Year	IP GAP $3.10/day (%) (00-14)	Years UNSC (46-99)	U.S. Eco. Aid (mill.) (46-99)
Sub-Saharan Africa							
Benin	BEN	2006, 2011/12	35.9	2003, 2011	36.2	2	14.1
Burkina Faso	BFA	2006, 2010	53.6	2003, 2009, 2014	37.3	2	25.2
Burundi	BDI	2005, 2010	49.2	2006	53.6	2	11.8
Cameroon	CMR	2004, 2011	26.7	2001, 2007, 2014	19.4	2	24.8
Congo, Democratic Rep.	COD	2007, 2010, 2013/14	39.5	2004, 2012	66.7	4	126.1
Congo, Rep.	COG	2009, 2011/12	19.5	2005, 2011	32.2	2	4.1
Côte d'Ivoire	CIV	2005, 2011/12	33.2	2002, 2008	21.4	4	14.3

Djibouti	DJI	2006	13.9	2002, 2012 2013	16.5	2	8.5
Gabon	GAB	2000, 2012	11.6	2005	7.2	4	3.3
Gambia	GMB	2005/06, 2013	32.3	2003	33.4	2	8.5
Ghana	GHA	2008, 2011, 2014	14.6	2005	19.6	4	64.1
Guinea	GIN	2005, 2012	48.3	2002, 2007, 2012	38.1	2	39.1
Guinea-Bissau	GNB	2006	46.2	2002, 2010	43.4	2	7.7
Kenya	KEN	2003, 2008/09, 2014	24.0	2005	25.5	4	69.8
Liberia	LBR	2007, 2013	43.0	2007	48.6	1	69.4
Madagascar	MDG	2004, 2008/09	38.5	2001, 2005, 2010, 2012	54.8	2	19.2
Mali	MLI	2006, 2012/13	50.8	2001, 2006 2009	37.2	2	41.8
Mauritania	MRT	2007, 2011	31.9	2000, 2004, 2008, 2014	11.1	2	11.9
Namibia	NAM	2006/07, 2013	19.0	2003, 2009	20.5	1	19.3
Niger	NER	2006, 2012	62.3	2005, 2007, 2011, 2014	43.0	2	33.2
Nigeria	NGA	2003, 2008, 2011, 2013	30.5	2003, 2009	39.3	6	79.9
Rwanda	RWA	2005, 2010 2014/15	34.5	2000, 2005, 2010, 2013	47.6	2	33.5
Senegal	SEN	2005, 2010/11, 2012/13, 2014	36.6	2001, 2005, 2011	30.6	4	50.6
Sierra Leone	SLE	2005, 2008, 2010, 2013	44.5	2003, 2011	38.9	2	17.7
Sudan	SDN	2010	32.1	2009	12.8	2	128.3
Tanzania	TZA	2008	35.0	2000, 2007, 2011	44.6	2	44.7
Togo	TGO	2006, 2010, 2013/14	26.2	2006, 2011	39.3	2	12.4
Uganda	UGA	2006, 2011	36.7	2002, 2005, 2009, 2012	34.5	3	31.7
Zambia	ZMB	2007, 2013/14	30.5	2002, 2004, 2006, 2010	42.7	6	54.1
Zimbabwe	ZWE	2006, 2010/11, 2014	16.0	2011	16.3	4	60.5
North Africa							
Egypt	EGY	2008, 2014	1.9	–	–	7	1948.7
Morocco	MAR	2004, 2007, 2010/11	7.6	2000, 2006	5.2	4	169.0
Tunisia	TUN	2003, 2011/12	0.7	2000, 2005, 2010	3.6	4	129.3
Middle East							
Iraq	IRQ	2006, 2011	5.2	–	–	4	10.0

Jordan	JOR	2007, 2009 2012	0.8	–	–	4	266.3
Yemen	YEM	2006, 2013	25.9	–	–	2	38.9
Latin America and the Caribbean							
Argentine	ARG	2005	1.1	2000-2014	4.2	13	39.0
Bolivia	BOL	2003, 2008	13.2	2000-2002, 2004-2009 2011-2014	12.9	4	163.3
Brazil	BRA	2003, 2006, 2014	2.4	2001-2009, 2011-2014	7.0	16	280.8
Colombia	COL	2005, 2010	3.1	2000-2005, 2008-2014	9.2	10	159.9
Ecuador	ECU	2003, 2013/14	1.1	2000, 2003-2014	9.0	6	55.3
Guyana	GUY	2005, 2009	4.2	–	–	4	18.1
Honduras	HND	2005/06, 2011/12	11.6	2001-2014	16.5	2	112.4
Jamaica	JAM	2010, 2012	0.7	2002, 2004	2.4	2	99.2
Mexico	MEX	2006, 2012	1.3	2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014	4.7	3	53.2
Nicaragua	NIC	2001, 2006/07, 2011/12	13.7	2001, 2005, 2009, 2014	10.9	4	84.1
Paraguay	PRY	2002/03	6.4	2001-2014	5.7	2	20.8
Peru	PER	2004, 2008, 2012	6.5	2000-2014	7.8	6	131.0
Trinidad and Tobago	TTO	2006	2.0	–	–	2	12.9
Uruguay	URY	2002/03	0.6	2000-2014	0.8	2	19.8
Eastern Europe							
Belarus	BLR	2005	0.0	2000-2014	1.1	2	53.4
Czech Republic	CZE	2002/03	1.0	2004-2012	0.1	2	6.6
Hungary	HUN	2003	1.6	2000-2005, 2007-2012	0.1	4	21.8
Slovenia	SVN	2003	0.0	2002-2012	0.2	2	1.6
Turkey	TUR	2003	2.8	2002-2013	1.6	5	603.3
Ukraine	UKR	2007, 2012	0.6	2002-2014	0.4	4	152.3
Asia							
Bangladesh	BGD	2007, 2011, 2012/13, 2014	22.9	2000, 2005, 2010	21.0	2	377.6
India	IND	2005/06	28.3	2004, 2009 2011	23.7	12	1181.4
Indonesia	IDN	2007, 2012	8.1	2000-2014	18.1	4	306.6
Nepal	NPL	2006, 2011, 2014	23.1	2003, 2010	23.7	4	41.0
Pakistan	PAK	2006/07, 2012/13	24.7	2001, 2004, 2005, 2007,	14.4	10	848.4

				2010, 2011 2013			
Philippines	PHL	2003, 2008, 2013	6.1	2000, 2003, 2006, 2009, 2012	13.0	4	415.5
Sri Lanka	LKA	2003	2.1	2002, 2006, 2009, 2012	5.1	2	84.1
Thailand	THA	2005/06	0.6	2000, 2002, 2004, 2006-2013	1.0	2	161.7

Table 1.B.2 – Data description and sources

Variables	Description	Sources
MPI	Average of Multidimensional Poverty Index (%) 2000–2014	OPHI
MPI H	Average of Multidimensional Poverty headcount ratio (%) 2000–2014	OPHI
IP GAP $3.10/day	Average income poverty gap at $3.10 a day (2011 PPP) 2000–2014	WDI
IP H $3.10/day	Average income poverty headcount ratio at $3.10 a day (2011 PPP) 2000–2014	WDI
IP GAP $1.90/day	Average income poverty gap at $1.90 a day (2011 PPP) 2000–2014	WDI
IP H $1.90/day	Average income poverty headcount ratio at $1.90 a day (2011 PPP) 2000–2014	WDI
UNSC	Total number of years a country has spent on the Security Council of the United Nations 1946–1999	UN website
AID	Average economic grants and loans from the United States 1946–1999 (in millions)	U.S. Agency for International Development
Growth	Annualised per capita growth rate, constant GDP (2010 US$)(%) 1960–1999	WDI
Per capita GDP	Average per capita GDP, constant (2010 US$)(%) 1960–1999	WDI
Trade	Average of trade (sum of exports and imports of goods and services) (% GDP) 1960–1999	WDI
Polity 2	Average of the revised combined polity score 1946–1999. The Polity score ranges from +10 (strongly democratic) to -10 (strongly autocratic)	Polity Project of the Center for Systemic Peace (Marshall et al., 2017)
Political Rights	Average of the Political Rights Score 1972–1999. The political rights score ranges from 1 (free) to 7 (not free)	Freedom House website
Civil Liberties	Average of the Civil Liberties Score 1972–1999. The civil liberties score ranges from 1 (free) to 7 (not free)	Freedom House website
Ethic Frac.	One year per country before 2001, country specific. The score ranges from 0 (not fractionalised) to 0.9 (highly fractionalised)	Alesina et al. (2003)
Language Frac.	One year per country before 2001, country specific. The score ranges from 0 (not fractionalised) to 0.9 (highly fractionalised)	Alesina et al. (2003)
Religious Frac.	One year per country before 2001, country specific. The score ranges from 0 (not fractionalised) to 0.9 (highly fractionalised)	Alesina et al. (2003)
Gov. Cons.	Average government consumption (% GDP) 1960–1999	WDI
Share US aid	Average U.S. aid (as % total aid received) 1960–1999. Ratio U.S. economic aid over total ODA gross loans and grants from DAC countries	OECD and U.S. Agency for International Development
Population Density	Average population density 1960–1999	WDI
Dummy RR	Dummy variable equal to 1 if the average total natural resources rents (% GDP) over 1970–1999 period is equal or larger than 10%	WDI

Table 1.B.3 – Summary statistics of the ten indicators considered in the MPI

Dimensions of Poverty	**Indicators**	Obs.	Mean	Std. Dev.	Min.	Max.
HEALTH	Nutrition	60	14.4	11.9	0	38.2
	Child mortality	61	19.9	16.5	0	55.9
EDUCATION	Years of Schooling	64	15.5	16.7	0	62.7
	School Attendance	58	18.3	17.1	0	63.7
LIVING STANDARDS	Cooking Fuel	62	34.3	29.7	0	90.7
	Sanitation	64	29.5	26.0	0	86.2
	Drinking Water	64	18.9	18.4	0	57.7
	Electricity	63	28.9	28.5	0	84.5
	Flooring	63	24.5	23.9	0	82.6
	Assets	64	19.9	18.8	0	67.2

Table 1.B.4 – Correlation matrix for 59 observations

Variables	MPI	MPI H	AID	UNSC	Growth	Pc GDP	Trade	Polity 2	Pop. dens.	AID/total
MPI H	0.99									
AID	-0.17	-0.17								
UNSC	-0.27	-0.27	0.46							
Growth	-0.33	-0.34	0.24	0.21						
Pc GDP	-0.54	-0.56	-0.14	0.12	0.23					
Trade	-0.24	-0.23	-0.25	-0.42	-0.16	0.22				
Polity 2	-0.43	-0.44	0.13	0.17	0.06	0.44	0.00			
Pop. dens.	-0.08	-0.07	0.22	-0.04	0.11	0.00	-0.19	0.32		
AID/total	-0.39	-0.41	0.36	0.15	0.08	-0.00	0.04	0.32	0.09	
Gov. Consumption	-0.18	-0.18	-0.10	-0.19	-0.23	0.20	0.67	-0.05	-0.26	-0.16

1.C Additional Tables of the Sensitivity Analysis

Table 1.C.1 – Sensitivity checks: main results for MPI indicators with adjusted p-values (2SLS estimation)

Outcome	Estimated aid coefficient	SE	Unadjusted p-value		Bonferroni (simple)		Holm		Hochberg	
Schooling	-0.103	0.043	0.016	**	0.160		0.080	*	0.027	**
Attendance	-0.088	0.042	0.038	**	0.380		0.114		0.048	*
Mortality	-0.052	0.026	0.046	**	0.460		0.114		0.051	*
Nutrition	-0.035	0.019	0.075	*	0.750		0.114		0.075	*
Electricity	-0.130	0.050	0.010	***	0.100	*	0.063	*	0.020	**
Water	-0.077	0.027	0.004	***	0.040	**	0.040	**	0.020	**
Sanitation	-0.117	0.044	0.007	***	0.070	*	0.063	*	0.020	**
Flooring	-0.119	0.044	0.007	***	0.070	*	0.063	*	0.020	**
Fuel	-0.137	0.058	0.019	**	0.190		0.080	*	0.027	**
Assets	-0.090	0.034	0.008	***	0.080	*	0.063	*	0.020	**

Notes: results correspond to main results from 2SLS estimations of table 5. Adjusted p-values for a significance level of 10%. *** p<0.01, ** p<0.05, * p<0.1.

Table 1.C.2 – Sensitivity checks: main results of the OLS estimation with adjusted p-values

Outcome	Estimated aid coefficient	SE	Unadjusted p-value		Bonferroni (simple)		Holm		Hochberg	
(a) Income Poverty $1.90/day										
Gap	-0.015	0.012	0.202		0.606		0.236		0.202	
H	-0.042	0.024	0.077	*	0.231		0.154		0.115	
(b) Income Poverty $3.10/day										
Gap	-0.026	0.016	0.118		0.354		0.236		0.177	
H	-0.040	0.026	0.133		0.399		0.154		0.133	
(c) Multidimensional Poverty										
MPI	-0.036	0.012	0.006	***	0.018	**	0.018	**	0.018	**
H	-0.057	0.022	0.011	**	0.033	**	0.033	**	0.033	**

Notes: results correspond to main results from OLS estimations that appear in columns (5), (6), (11), (12), (17) and (18) of Table 2. Adjusted p-values for a significance level of 10%. *** p<0.01, ** p<0.05, * p<0.1.

Table 1.C.3 – Sensitivity checks: main results for MPI indicators for 58 countries (2SLS estimation)

	Education		Health		Living Standard					
	(1) Schooling	(2) Attendance	(3) Mortality	(4) Nutrition	(5) Electricity	(6) Water	(7) Sanitation	(8) Flooring	(9) Fuel	(10) Assets
AID	-0.124**	-0.088**	-0.054*	-0.033*	-0.154**	-0.086***	-0.132**	-0.143**	-0.161**	-0.104**
	(0.052)	(0.042)	(0.031)	(0.020)	(0.061)	(0.033)	(0.053)	(0.056)	(0.071)	(0.042)
Observations	58	58	58	58	58	58	58	58	58	58
Outcome mean	16.8	18.3	21.1	14.9	31.4	20.2	31.9	26.6	36.8	21.5
AID mean	119.0	119.0	119.0	119.0	119.0	119.0	119.0	119.0	119.0	119.0
F-test	37.34	25.80	39.15	29.31	39.22	37.34	37.34	37.90	45.09	37.34
T-test	6.11	5.08	6.26	5.41	6.26	6.11	6.11	6.16	6.71	6.11

Notes: Robust standard errors in parentheses. Covariates, regional dummies and outliers are included in all the regressions. F-test is the first-stage test of excluded instruments and T-test is from the UNSC variable. Covariates include per capita GDP growth, population density, trade (% GDP), per capita GDP and polity 2. Outliers are India, Pakistan and Argentina (there is no information for Egypt in the sample of 58 countries). India and Pakistan are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2); Argentina is the outlier in the UNSC-AID relationship (cf. figure 1.4.2). Regional dummies are Latin America, Europe and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

Table 1.C.4 – Sensitivity checks: main results for multidimensional poverty for 58 countries (OLS estimation)

	(1) MPI	(2) H	(3) MPI	(4) H	(5) MPI	(6) H
AID	-0.011	-0.016	-0.061***	-0.101***	-0.039**	-0.058**
	(0.011)	(0.018)	(0.019)	(0.032)	(0.015)	(0.025)
Observations	58	58	58	58	58	58
Covariates	No	No	Yes	Yes	Yes	Yes
Outliers	No	No	Yes	Yes	Yes	Yes
Regional dummies	No	No	No	No	Yes	Yes

Notes: Robust standard errors in parentheses. Covariates include per capita GDP growth, population density, trade (% GDP), per capita GDP and polity 2. Outliers for multidimensional poverty regressions are India and Pakistan (Egypt is not included in the sample of 58 countries). India and Pakistan are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2). Regional dummies are Latin America, Europe and Asia (Africa is the reference dummy. There is no income poverty information for the Middle East economies considered in the study). *** p<0.01, ** p<0.05, * p<0.1.

Table 1.C.5 – Sensitivity checks: main results for first measures of poverty with time dummies (OLS estimation)

	IP $1.90/day		IP $3.10/day		Multidimnesional Poverty	
	(1) Gap	(2) H	(3) Gap	(4) H	(5) MPI	(6) H
AID	-0.020	-0.044*	-0.031*	-0.038	-0.040**	-0.056**
	(0.014)	(0.024)	(0.018)	(0.027)	(0.016)	(0.026)
Observations	58	58	58	58	64	64
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. Covariates and outliers included in all the regressions. Covariates are per capita GDP growth, population density, trade (% GDP), per capita GDP and polity 2. Outliers for income poverty regressions are India and Pakistan (India and Pakistan are the outliers in the income poverty-AID relationship (cf. figures 1.A.1 and 1.A.2 in the Appendix); for multidimensional poverty regressions are India, Pakistan and Egypt (India, Pakistan and Egypt are the outliers in the multidimensional poverty-AID relationship (cf. figure 1.3.2). Regional dummies for income poverty regressions are Latin America, Europe and Asia (Africa is the reference dummy. There is no income poverty information for the Middle East economies considered in the study). Regional dummies for multidimensional poverty regressions are Latin America, Europe, the Middle East and Asia (Africa is the reference dummy). *** p<0.01, ** p<0.05, * p<0.1.

Chapter 2

The Impact of the Expansion of African Palm Crop on Child Undernutrition in South-West Guatemala

2.1 Introduction

The agriculture sector in Guatemala has been the key driver of economic growth during the last decade in the country (Sanchez et al., 2016). It is marked by a duality, with a more recent world leading export sector that includes sugar, palm oil, coffee, cardamom and bananas as top 6 export commodities between 2013 and 2015 (United Nations, 2017); and a more traditional one, less productive but more important to indigenous and peasant families, around the production of maize and beans mainly.[1] Guatemala's Agricultural Ministry estimates that nearly 0.8 million households are small-scale commercial and subsistence agriculture producers, cultivating corn and beans in almost one-third of the cultivated agricultural area in Guatemala (Sanchez et al., 2016).

I am very grateful to seminar participants at the 67th Annual Meeting of the French Economic Association (AFSE), at the Internal Seminar of the IIEP-BAIRES at the University of Buenos Aires and at the PhD Seminar of EconomiX at the University Paris Nanterre for helpful comments and suggestions; to my very good friend Viviana Perego whithout whom this project wouldn't have seen the light and together with my very good friend Alzbeta Mangarella they have both provided me with invaluable help in the design of this research, with excellent technical assistance and have encouraged me all along the path; to Cécile Couharde, Doug Gollin, Roxana Maurizio, Roberto Bisang, Daniel Heymann, Dominique Meurs, Léonore Raguideau, Mathieu Sanch-Maritan, Adrián Rodriguez and Rodrigo Martínez for their contribution in reading, commenting and shaping this research; and to Guatemalean and Argentinian friends and family, Gabriela Porras, Marcelo Acsebrud, Jorge de León and Percy Cantillo, for having introduce me to the beautiful and difficult reality of Guatemala and enrich the story this research wishes to tell.

[1] Indeed, the fundamental basis of food in Guatemala are corn tortillas, which are an institution, and flipped beans.

The agro-industrial production of palm oil in Guatemala has been growing since the 1980s. The industry is vertically integrated, with five companies dominating national production, and the yields of palm oil in Guatemala are among the highest in the world, with 7 tons per cultivated hectare compared to a world average that ranges between 3 to 4 (Solomon and Bailis, 2013). With the world's largest growth in exports in the last 20 years, the country has become the fifth world exporter, with palm oil exports representing 1.1% of the international market (CABI, 2017) and 2.7% of national exports in 2015 (United Nations, 2017). African palm is currently being cultivated in 8 departments of the country. In two of them that are located in the south-west region, Quetzaltenango and San Marcos, the expansion that took place between 2007 and 2015 in the share of cultivated hectares with african palm has doubled that of the rest of the country, and it represented 4.08% of the total area of both departments in 2015, compared to only 2.04% in the rest of Guatemala.

In these two departments, the expansion of african palm crop has initially replaced cotton and cattle plantations. However, since 2010, it has involved deforestation, illegal dredging of rivers, the improper use of water resources and the purchase and forced dispossession of communal and family lands of the indigenous population, which not only represents a destructuration of the established order within families and within indigenous communities but also compromises the nutritional health of the most vulnerable members, such as children and women (Castro et al., 2015). Studies such as Ávila-Romero and Albuquerque (2018) and (Sabogal, 2013) provide evidence about the social and environmental effects of the expansion of african palm crop in Brazil, Mexico and Colombia. Sabogal (2013) analyses, through spatial econometric techniques, the relationship between african palm cultivation and forced displacement in areas where the crop has been expanding between 1997 and 2009 in Colombia. More recently, through descriptive data from a fieldwork carried out between 2014 and 2017, Ávila-Romero and Albuquerque (2018) discuss how the agro-industrial production of palm oil in Mexico and Brazil has involved changes in the ownership of agricultural land from communal or individual property to agribusiness; intensive deforestation and forced displacement of population; poor working conditions, incluiding child labour, that contributes to enhance social and economic marginalization; and dependence on cash crops, at the expense of food crops or local consumption, which raises questions about long-term local food security and possible economic vulnerability.

According to these findings, the means through which the expansion of african palm crop in the Latin American continent is being carried out, is affecting the pre-established order within communities, contributing to increasing social and food security vulnerabilities. The current study is able to provide new evidence on the impact of the recently rapid expansion of african palm crop that is taking place in south-west Guatemala since 2010, on the nutritional health of children under five. It relies on a difference-in-difference empirical strategy that compares the pre-to-post

change in nutritional outcomes of the treated sample – children under five years of age living in Quetzaltenango and San Marcos – to the change in nutritional outcomes of the control sample – children under five years of age living in the rest of departments in Guatemala without african palm crop. The outcomes of interest are the standard measures deffined by the World Health Organisation (WHO) of child undernutrition in terms of z-scores ((severe) stunting, (severe) wasting, (severe) underweight).[2] The study uses data from the last four waves of the National Maternal and Children's Health Survey (ENSMI), which enables to build a pre-treatment period for the years 1998/1999, 2002 and 2008/2009, and a post-treatment period for 2014/2015.

Controlling for a large set of observable characteristics that allow to mitigate concerns of selection bias, the results from the analysis suggest that the accelerated expansion that has taken place in these departments since 2010 and which has involved water pollution and the destructuration of the established order within indigenous communities, has a signifcant impact on deteriorating children's nutritional health in south-west Guatemala.[3] More precisely, the study founds that the probability that a child under five years of age suffers from chronic malnutrition, is significantly increased by 6.1 percentage points (p.p.) – on average – if she/he lives in Quetzaltenango or San Marcos and, thus, is affected by the treatment. The heterogeneity analysis shows that the effect particularly concerns children from indigenous mothers (7.0 p.p.), living in urban areas (15.2 p.p.) and in households where the head of the family is a man (7.6 p.p.). These results are robust when the control sample only considers children living in the other departments from the south-west region where african palm does not grow; when applying matching techniques to reduce heterogeneity among samples; when controlling for the tropical storm Agatha that frapped Guatemala by 2010; when doing falsication tests by modifying the pre/post period; and when modifying the control sample to only consider children living in departments that are suitable for african palm cultivation but where the crop has not yet expanded. Additional analysis also shows that children between two and five years of age are those particularly affected. This suggests that the rapid expansion of african palm crop in Quetzaltenango and San Marcos contributed to a deficient nutritional intake of children born between 2010 and 2013, increasing their probability of being irreversibly stunted after the age of two.

The article belongs to the stream of literature analyzing the social and environmental effects of agribusiness expansion in Guatemala. For instance, Tomei (2015) analyses the impact on the access to land, labor and legal compliance of ethanol production from sugarcane certified as sustainable by the European Union Renewable Energy Directive (EU RED). The study highlights that the EU Normative does not capture the problems faced by the local population in Guatemala, which

[2] Please, refer to the Appendix A for a detailed description of how these measures are calculated.

[3] This result is measuring the impact of the expansion of african palm in Quetzaltenango and San Marcos as a whole, without being able to distinguish the impact of each of the practices through which this expansion has taken place.

endangers rural communities. Alonso-Fradejas et al. (2008) describe well the impact of biofuels production from palm oil and sugarcane in Guatemala as well as the lack of a national regulatory framework used by the state to promote and support these activities. They further highlight the illegal dredging of rivers and the forced displacement of indigenous communities, claiming that the energy crisis is seen as an opportunity for agribusiness in Guatemala, which in turn exacerbates already existing problems for the environment, the poorest and the indigenous population. However, there is no empirical evidence of the effects on food security and the nutritional health of the most vulnerable population, a gap in the literature that this study contributes to fill.

The rest of the paper is organised as follows. Section 2.2 is dedicated to the context of Guatemala and the analytical framework that hereby applies. Section 2.3 introduces the empirical and identification strategies that are used in the analysis. Section 2.4 presents the data and the descriptive statistics of the sample of analysis. Section 2.5 provides main results from the difference-in-difference estimation and the heterogeneity analysis. Robustness checks are reported in Section 2.6. Section 2.7 adds further analysis, and section 2.8 concludes.

2.2 Context and Analytical Framework

Palm oil is the new leader in agricultural production in Guatemala. Since 2006, exports to Latin America and Europe have grown at an average annual rate of 20%[4], supplying the growing international demand for biodiesel. Between 2003 and 2015 the number of hectares cultivated with African palm has expanded from 24,209 to 164,049 (INE, 2004, 2016), which represents an annual growth of 17.3% and 4% of the agricultural land in Guatemala in 2015 (CABI, 2017).

Contrary to south-east Asia where over half of the hectares with african palm are cultivated by smallholders – for instance, 44% in Indonesia and 76% in Thailand – (Pirker and Mosnier, 2015), the industry in Guatemala is vertically integrated, with five companies dominating national production (Alonso-Fradejas et al., 2011). According to Global Forest Watch[5], among these five companies only one located in north-east Guatemala is RSPO certified.[6]

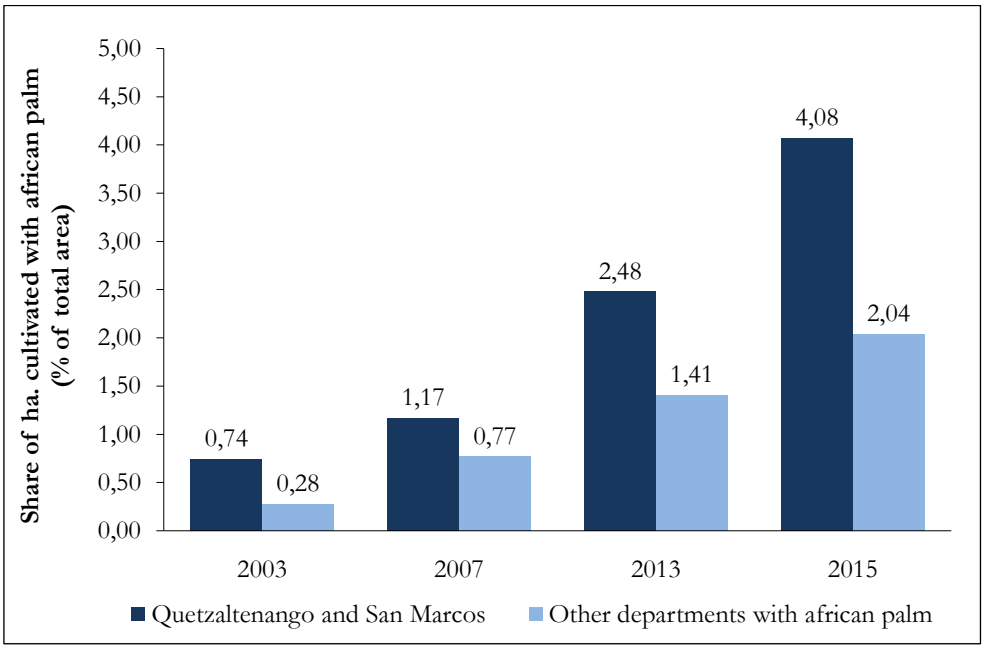
To date, african palm is being developed in eight departments of the country. In two of them that are located in the south-west region, Quetzaltenango and San Marcos, the percentage of hectares cultivated with african palm has increased much more over the last decade and represents a larger share of the total area of both departments, compared to what is observed in the rest of Guatemala. Figure 2.2.1 shows that the share of land cultivated with african palm in Quetzaltenango and San

[4]Calculations made from UNCOMTRADE data. Please, see Appendix B for a graphical representation on this.
[5]www.globalforestwatch.org
[6]The Roundatable Sustainable Palm Oil (RSPO) was established in 2004 by the agro-industries of Malaysia and Indonesia in order to promote the production of sustainable palm oil, providing an answer to environmental and social concerns expressed by NGOs and the global society (Feintrenie, 2012).

Marcos has increased almost 3 percentage points (p.p.) between 2007 and 2015 and, by that year, represented 4.08% of the total area. Meanwhile, the percentage of hectares with african palm crop in other departments has only expanded 1.27 p.p. in the last decade and the share of total land that covered in 2015 was 2.04%.

Moreover, since 2010, the expansion of african palm crop in Quetzaltenango and San Marcos has led to illegal dredging of rivers, inappropriate use of water resources and land grabbing of indigenous peasant communities, compromising food and nutritional security of the most vulnerable population (Castro et al., 2015). Indeed, industrial cropping of african palm in adult age demands a significantly high amount of water that, in times of high temperatures, can range between 42,000 and 49,000 liters per day and per hectare[7] (Hortúa, 2014). This leads to these plantations to compete for the use of water resources in the irrigation of traditional crops of staple grains (corn and beans) consumed by the communities.

Figure 2.2.1 – Share of hectares cultivated with african palm (percentage of total area)



Source: National Agricultural Census 2003 and National Agricultural Survey 2007, 2013 and 2015

Additionally, the cases documented in the study carried out by the Coordination of NGOs and Cooperatives of Guatemala (Castro et al., 2015), point out that wastewater of african palm crop,

[7] Between 300 and 350 liters per african palm tree and considering that one hectare can grow around 140 palm trees.

which has a high content of fertilizers and pesticides, is discharged into the rivers Ocosito and Pacayá (in Quetzaltenango and San Marcos, repectively), jeopardizing regional biodiversity (fauna and flora), reducing the availability of fishes, flooding the agricultural lands of families during the rainy season and exposing the population of urban and rural areas to harmful substances for their health.

The growing model of african palm crop in the two departments of the south-west region of Guatemala also differs from the one developed in south-east Asia. For instance in Indonesia, two schemes within the production of palm oil coexist: one consisting on a contract signed between a company, smallholders, and banks, with the supervision of the government and under the name Nucleus Estates and Smallhoders (NES), where the company plants, manages and collect the crop, giving the landowner a percentage of the revenue; and another where the farmer independently develops its oil palm plantation and sell the fruit to the industry in charge of the oil extraction. Smallholders can thus be organised within cooperatives, learning how to improve their plantations, or included in partnerships with companies, with a strong support of public policies (Feintrenie, 2012).

In the south-west region of Guatemala, african palm has initially replaced the cultivation of cotton and occupied lands that were previously used for cattle grazing. Nontheless, in the recent years, the expansion of this monoculture has also involved deforestation and purchase and forced dispossession of communal and family lands of the indigenous population (Castro et al., 2015). Indeed, in order to expand the plantations, companies seek to buy the agricultural land of the farmers. If the landowner refuses to sell, the company uses other mechanisms such as immediate money supply in amounts greater than the local price of land, or threats, coercion and violence. It is also frequent that the company gradually purchases plots of land, closing the access to roads and water resources to the peasants, surrounding the landowner and forcing him or her to sell (Hurtado, 2008). Other strategies used by companies is the offer of employment in oil palm farms. The study done in Castro et al. (2015) documents that most of the hired employees are men under 40 years of age, but also highlights the substantial presence of women and child labour, which represents around 25% and 11% respectively. As a result, the affected families not only become dependent on the income received from this activity and the labor conditions imposed to them, but additionally, they have less access to food due to the total or partial loss of their farmland.

In addition, the dispossession of family and communal agricultural lands, as well as the excessive and poorly paid work hours of male household heads in african palm plantations, implies an increase and lengthening of daily working hours for women (Castro et al., 2015). Consequently, women are not only in charge of the unpaid reproductive and domestic tasks in the household, but they also need to take care of other activities that the partner used to previously carried out - for

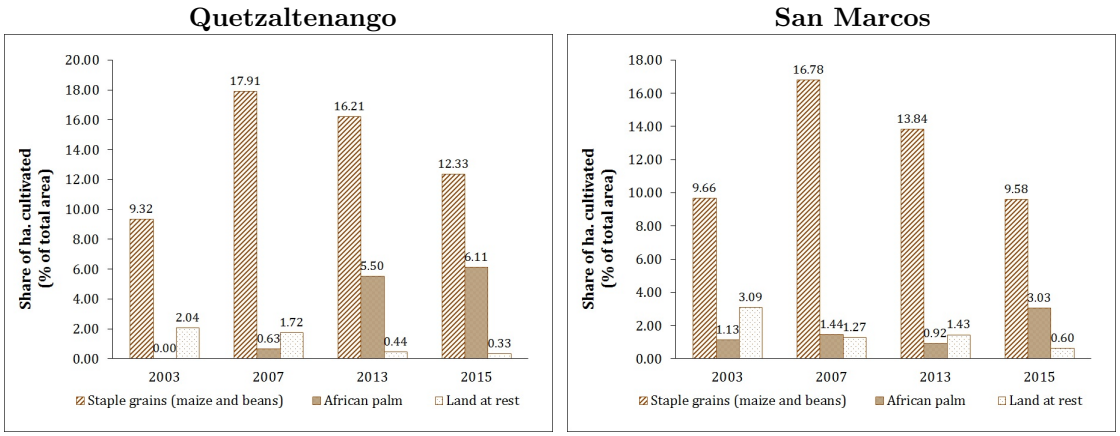
instance, look for firewood or buy corn. However, in most cases, women are also forced to work in the oil palm industry or migrate to urban areas in search of complementary jobs that allow them to complete family income. This situation not only represents a destructuration of the established order within families and within indigenous communities but also compromises the nutritional health of the most vulnerable members, such as children and women.

Indeed, the expansion of african palm plantations in the south-west region of Guatemala seems to have contributed to the considerable loss of hectareas that were previously dedicated to the production of staple food. When the companies acquire the land, the small and medium farmers stop producing food that was used for their own family consumption, but also products that could be sold in the internal market – such as staple grains (rice, maize and beans), dairy products, and meat. Moreover, some of these farmers also used to rent part of their agricultural lands to other peasants families, that did not have access to land, for the production of staple grains. The acquisition of these lands by the companies, thus contributes to not only reduce the availability of food in the internal market but also confronts these landless families to migrate and relocate themselves in a more precarious way in some other place (Hurtado, 2008).

Using data from the National Agricultural Census 2003 and the three last waves of the National Agricultural Survey (2007, 2013 and 2015), I show in Figure 2.2.2 the evolution of the share of hectares cultivated with staple grains (maize and beans), african palm and the share of land that is set to rest, as percentage of total area in Quetzaltenango and San Marcos between 2003 and 2015. It is noteworthy that the percentage of land dedicated to staple grains in Quetzaltenango has decreased 5.6 p.p between 2007 and 2015, whereas the share of cultivated land with african palm has increased 5.5 p.p. In San Marcos the increase in african palm cultivation is lower – around 2 p.p. – than the decrease in the staple grains – around 7 p.p.. It is not possible to withdraw conclusions from this figure but it is just used here as to observe that part of the expansion of african palm crop in the two departments of the south-west region of Guatemala might have taken place at the expense of less land to cultivate staple grains used for the consumption of peasant families.

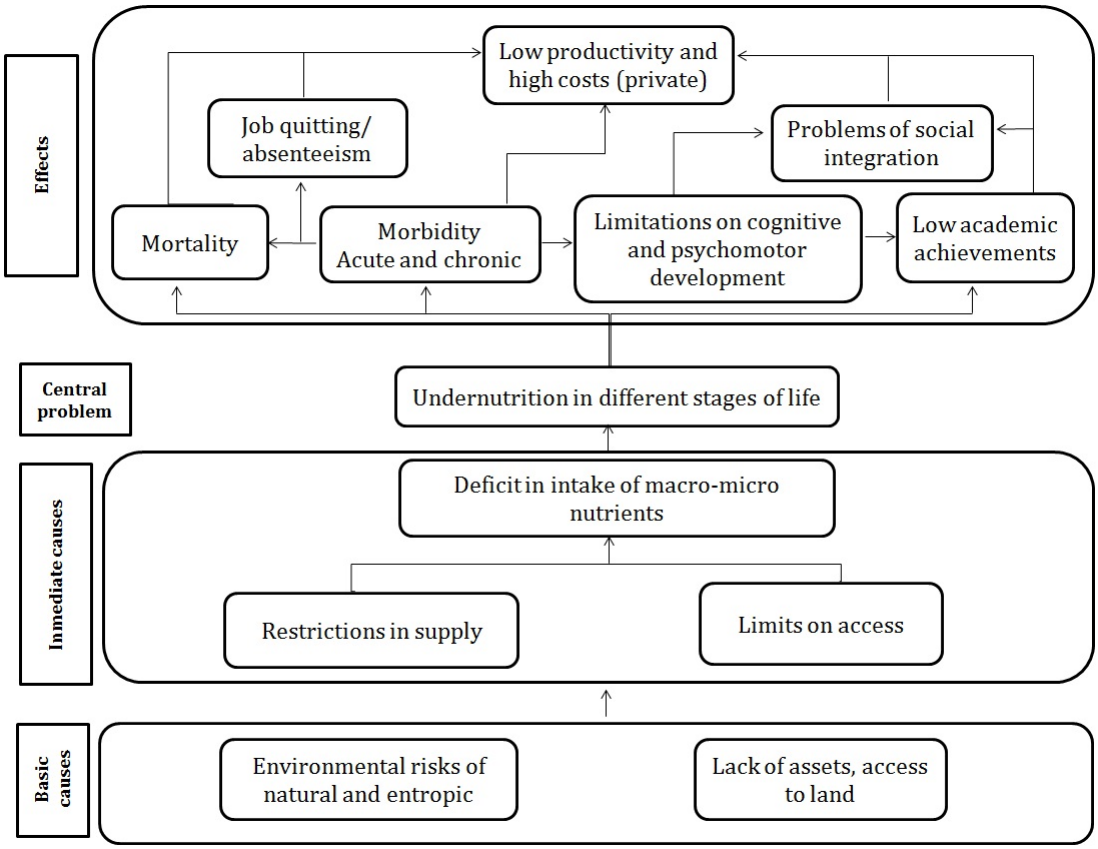
Following Martínez and Fernández (2007), this reduction in the availability of staple food caused by entropic factors – water pollution, decrease in the access to water resources and forced restriction in the access to land –, could lead to a deficient intake of nutrients, which, if accumulated in time, might end by causing undernutrition in different stages of life. Figure 2.2.3 represents an analytical framework that helps to understand the impact that the means through which the expansion of african palm crop has taken place in Quetzaltenango and San Marcos could have on the nutritional health of the most vulnerable population.

Figure 2.2.2 – Share of hectares cultivated (percentage of total area) in affected departments



Source: National Agricultural Census 2003 and National Agricultural Survey 2007, 2013 and 2015

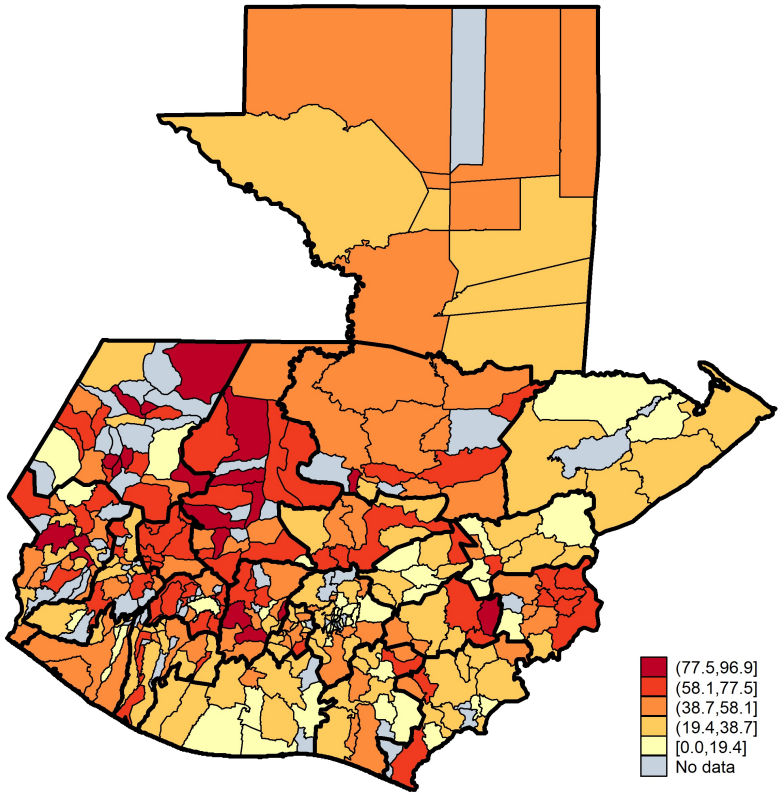
Figure 2.2.3 – Causes and consequences of undernutrition



Source: own creation from Martínez and Fernández (2007)

This is particularly relevant in the context of Guatemala since its population is affected by a specific type of undernutrition, which is already structural, and concerns almost one in every two children under five years of age in the country. Indeed, according to the latest data from the National Maternal and Children's Health Survey (ENSMI, 2014/2015), 46.5% of children under five present low height for their age – stunting or chronic malnutrition[8] –, a percentage that increases in the municipalities of the west regions of Guatemala, where most of the indigenous people live. Figure 2.2.4 shows that in these regions, the share of children facing low height for their age reaches 60% to 90% in some municipalities, compared to the rest of the country where the average share is not higher than 40%.

Figure 2.2.4 – Share of children under five with low height-for-age in 2014/2015 in Guatemala



Source: National Maternal and Children's Health Survey (ENSMI) 2014/2015

This type of undernutrition reflects the cumulative effects of deficient diets and infections even before birth, which is an indication of poor environmental conditions that restrict the growth po-

[8]Please, refer to the Appendix A for a detailed description of how these measures are calculated.

tential of the child in the long term (WHO, 2010). The consequences of chronic malnutrition are an increased risk of illness and death, delayed mental development, poor school perfomance and reduced intellectual capacity. These limitations in the development of cognitive and psychomotor abilities translates into problems of social integration during the adult life, which in turn tends to reduce labor productivity and increase public and private costs, affecting the economic development of the society in the long term (Martínez and Fernández, 2007) and implying a greater risk of intergenerational transmission of malnutrition (WHO, 2010).

Undernutrition affects all groups within a community but children are those who are most vulnerable to it since they require higher nutritional intake for their growth and development (Blossner et al., 2005). Therefore, the analysis in this article focuses on the impact that the rapid expansion of african palm crop in the two affected departments of the south-west region of Guatemala has on the nutritional health of children under five years of age.

2.3 Empirical Strategy and Identification

Following this specific context, the current study seeks to analyse whether the recently rapid expansion of african palm crop that is taking place since 2010 in the two departments of the south-west region of Guatemala – Quetzaltenango and San Marcos – significantly deteriorates the nutritional health of children living in these departments. The treatment is, hence, defined as this accelerated expansion that has taken place in these two departments since 2010 and which has involved water pollution and the destructuring of the established order within indigenous communities. In order to do this, the analysis focuses on comparing children's nutritional outcomes between the treated region – Quetzaltenango and San Marcos – and the control region – rest of the departments of Guatemala, excluding those six where african palm is also cultivated.[9]

Two empirical strategies are used: difference-in-difference regression and propensity score matching with difference-in-difference. Both strategies compare the pre-to-post treatment change in nutritional outcomes of children under five years of age in the region where the treatment takes place – Quetzaltenango and San Marcos – to the change in nutritional outcomes of children under five years of age in the region not affected by the treatment – rest of departments in Guatemala without african palm crop.

To explain this more precisely, let Y_{1idt} be the nutritional outcome of interest – which are the different measures of undernutrition as defined by the World Health Organisation (WHO) ((severe) wasting, (severe) stunting and (severe) underweight[10] – of child i living in department d at period

[9] Proceeding as such, allows to exclusively focus on the impact of the rapid expansion of african palm in Guatemala, which has implied bad environmental and social practices, and differentiate it from the effect that its cultivation could have in the economy of the country, which is not the scope of this paper.

[10] Wasting (low height-for-weight) or acute malnutrition, stunting (low height-for-age) or chronic malnutrition

t if the department is affected by the recently rapid expansion of african palm cultivation, and let Y_{0idt} be the nutritional outcome of the child i living in department d at period t if the department is not affected by the recently rapid expansion of african palm cultivation. Ideally, one would like to compare Y_{1idt} with Y_{0idt}, which are the potential outcomes for the same child. However, in practice, we only get to see one or the other, never both. For instance, it is not possible to observe the nutritional outcome of child i after the treatment, had the treatment not taken place, which is called the counterfactual outcome. For this reason, in order to analyse whether the recently rapid expansion of african palm crop in south-west Guatemala has a significant impact in deteriorating nutritional outcomes of children under five years of age, the estimation needs to rely in the comparison of nutritional outcomes between the treated and the non-treated (control) sample.

Additionally, let γ_d be a dummy variable equal to 1 if the child lives in a department d that is affected by the treatment – Quetzaltenango and San Marcos – and equal to 0 if she/he lives in a department d that is not affected by the treatment - the rest of Guatemala not concerned by the african palm cultivation. In this sense, γ_d measures the time-invariant department differences between the treated and control departments that may affect the nutritional status of child i. Let λ_t be a dummy variable equal to 1 if the child is observed and measured in the post-treatment period and equal to 0 if she/he is observed and measured in the pre-treatment period. This variable measures the common temporal trend of both the control and treated departments. Finally, let's denote D_{dt} the dummy variable that measures the treatment a child living in department d receives at period t – whether she/he lives by 2010 in a department that is characterised by the rapid expansion of african palm crop –, and which is equal to 1 if the child is observed and measured in any of the two departments in the post-treatment period and thus receives the treatment, and 0 otherwise. Accordingly, the observed nutritional outcome of child i living in department d at period t can be written as follows:

$$Y_{idt} = \gamma_d + \lambda_t + \delta D_{dt} + \varepsilon_{idt} \tag{2.3.1}$$

where ε_{idt} is the error term assumed of mean 0 – i.e., $E(\varepsilon_{idt}|d,t) = 0$. In the absence of the treatment, the observed average nutritional status can be written as follows:

$$E[Y_{0idt}|d = C, t] = \gamma_d + \lambda_t \tag{2.3.2}$$

where C stands for *control*. The pre-to-post treatment change – *first difference* – can be written as follows:

$$E[Y_{0idt}|d = C, t = POST] - E[Y_{0idt}|d = C, t = PRE] = \lambda_{POST} - \lambda_{PRE} \tag{2.3.3}$$

and underweight (low weight-for-age) or global malnutrition (acute and chronic malnutrition). Please, refer to the Appendix A for a detailed description of how these measures are calculated.

In presence of the treatment, the observed average nutritional status can be written as follows:

$$E[Y_{1idt}|d = T, t] = \gamma_d + \lambda_t + \delta \tag{2.3.4}$$

where T stands for *treated*. Its pre-to-post treatment change – *second difference* – can be expressed as follows:

$$E[Y_{1idt}|d = T, t = POST] - E[Y_{1idt}|d = T, t = PRE] = \lambda_{POST} - \lambda_{PRE} + \delta \tag{2.3.5}$$

Accordingly, the population difference-in-difference can be expressed as:

$$\begin{aligned} E[Y_{idt}|d = T, t = POST] - E[Y_{idt}|d = T, t = PRE] \\ - E[Y_{idt}|d = C, t = POST] - E[Y_{idt}|d = C, t = PRE] \\ = E[Y_{1idt}|d = T, t = POST] - E[Y_{1idt}|d = T, t = PRE] \\ - (E[Y_{0idt}|d = C, POST] - E[Y_{0idt}|d = C, PRE]) \\ = \lambda_{POST} - \lambda_{PRE} + \delta - (\lambda_{POST} - \lambda_{PRE}) = \delta \end{aligned} \tag{2.3.6}$$

where δ is the causal effect of interest, thus the effect of the recently rapid expansion of african palm crop, and the means through which it has taken place, on the nutritional outcomes of children under five in the two departments of the south-west region of Guatemala. This can be estimated using the population means from the analysed sample (Angrist and Pischke, 2008).

Table 2.3.1 – Average share of children under five with low height-for-age in treated and control departments before and after the treatment

Variable	Treated (T)	Control (C)	Difference: (T) - (C)
POST: Average stunting after	52.77	45.57	7.20
	(0.50)	(0.50)	(0.02)
PRE: Average stunting before	52.44	49.08	3.36
	(0.50)	(0.50)	(0.02)
Difference: POST - PRE	0.33	-3.50	**3.84**
	(0.02)	(0.01)	**(0.25)**

Note: robust standard errors clustered at household level in parentheses. Weighting is according to the weight of the household.
Source: National Maternal and Children's Health Survey (ENSMI)

The four cells in Table 2.3.1[11] show, for instance, the average share of children under five stunted (with low height for their age or facing chronic malnutrition) in the treated (Quetzaltenango and

[11] Based on Table 5.2.1 of Angrist and Pischke (2008), pp 230.

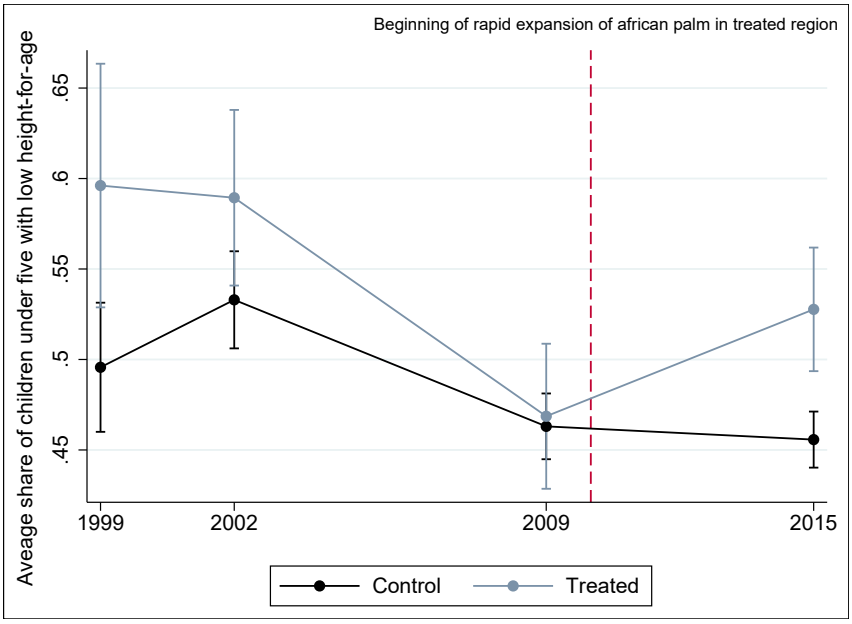
San Marcos) and the control (rest of Guatemala not cultivating african palm) departments before and after the rapid expansion of african palm crop in the two departments of south-west Guatemala. The margins show differences between the average incidence of stunting in the treated and control departments for each period, the pre-to-post change in each sample, and the difference-in-difference. The average share of children with low height for their age is higher in the treated departments and in both periods. However, whereas the incidence decreases over time in the control sample, it slightly increases in those departments affected by the rapidly expansion of african palm crop. These two changes produce a positive difference-in-difference, suggesting that the recently rapid expansion of african palm crop, and the means through which it has taken place, has increased the average share of stunted children in the two departments of south-west Guatemala.

In order to claim the validity of this evidence, both groups – the treated and the control – need to be comparable. This means that the trend of the average incidence of stunted children would be the same in both groups in the absence of the treament, so that the increase in the percentage of stunted children in the treated group, once the treatment is in place, can exclusively be attributed to the treatment (Angrist and Pischke, 2008). Indeed, as previously noted, because it is not possible to observe the nutritional outcome of child i after the treatment had the treatment not taken place, the analysis need to rely in the comparison of nutritional outomes between treated and non-treated children. However, by doing so, equation 2.3.6 might add a term called *selection bias* measuring the potential differences among groups that may help explain why children living in Quetzaltenango and San Marcos received the treatment, whereas those living in the rest of Guatemala (excluding the other departments where african palm is also cultivated) did not. When these differences are not significantly different from zero, the assignment of the treatment is said to be independent of the health status of the children and hence, there is nothing that could explain significant differences in the nutritional outcomes of children during the pre-treatment period. In this case, it would be possible to observe a *common trend* in the average incidence of low height-for-age among treated and control samples during the pre-treatment period.

Figure 2.3.1 plots the likelihood of children under five facing a situation of low height for their age in the treated and control departments of Guatemala between 1999 and 2015. The vertical bar is for 2010, when the rapid expansion of african palm began in Quetzaltenango and San Marcos. The share of stunted children is always higher in the treated departments, although the trend is decreasing during the pre-treatment period. In the control departments, despite a slight increase between 1999 and 2002, the average incidence of stunting decreases during the whole period. The 95% confidence intervals show that the difference of low height-for-age between samples is not statistically significant during the pre-treatment period, whereas once the treatment is in place, a statistically significant higher incidence of stunting among children under five is found in the treated departments. This figure provides visual evidence of a *common trend* characterising the

evolution of the share of stunted children in both treatment and control departments during the pre-treatment period, and a treatment effect that seems to induce a deviation from it.

Figure 2.3.1 – Average share of children under five with low height-for-age in treated and control departments



Note: weighting is according to the weight of the household. Confidence intervals at 95% confidence level.
Source: National Maternal and Children's Health Survey (ENSMI).

However, the slight differences in the trend between samples during the pre-treatment period might hint significant differences among treated and control departments that could help explain the assignment of the treatment. In this sense, the causal effect of interest from equation 2.3.6 might thus be masked by a *selection bias* term. Indeed, table 2.3.1 shows that the difference-in-difference, although positive, is not statistically significant. When the treatment D_{dt} is randomly assigned, Angrist and Pischke (2008) suggest that the selection bias term disappears making the treated and control groups comparable. In this case, a simple regression of Y_{idt} on γ_d, λ_t and δD_{dt} – like in equation 2.3.1 – would thus give the average causal effect of the rapid expansion of african palm crop on those children who live in the treated departments. Nonetheless, when this is not the case, one solution is to include in the regression a variety of control variables X_{it} that could help explain the difference in nutritional outcomes between treated and non-treated children. That is, to account for those relevant observable characteristics that could help explain what causes a child to live in Quetzaltenango or San Marcos and, hence, be affected by the rapid expansion of african palm and the means through which it has taken place.

This lead to the *Conditional Independence Assumption* (CIA) or what it is also called *selection on observables* because these variables X_{it} that might help explain the selection of a child to receive the treatment are assumed to be known and observed (Angrist and Pischke, 2008). The CIA is a core assumption that tells that, conditional on the observed characteristics X_{it}, the selection bias disappears and hence, the comparison of average nutritional outcomes across treated and non-treated children has a causal interpretation. Formally, the CIA can be written as:

$$\{Y_{0idt}, Y_{1idt}\} \perp D_{dt} | X_{it} \tag{2.3.7}$$

which means that, conditional on the observable variables X_{it}, the potential nutritional outcomes of treated and non-treated children are independent of the treatment assignment and, thus, both groups can be indeed compared[12] so that δ would represent the causal effect of interest. Accordingly, equation 2.3.1 can be re-written as follows:

$$Y_{idt} = \gamma_d + \lambda_t + \delta D_{dt} + X'_{it}\zeta + \varepsilon_{idt} \tag{2.3.8}$$

In practice, the regression that is estimated in the main analysis is a linear probability model for child i that lives in the department d in the year t and is specified as follows:

$$Y_{idt} = \alpha_1 Treat_d + \alpha_2 After_t + \underbrace{\delta}_{\text{ITT}} Treat_d \times After_t + \theta_d + \beta_t + X'_{it}\zeta + \varepsilon_{idt} \tag{2.3.9}$$

where Y_{idt} is a binary variable equal to 1 if the child suffers from any kind of undernutrition (acute, chronic or both) and 0 otherwise. $Treat_d$ is a dummy variable equal to 1 if the child lives in any of the two treated departments – equivalent to γ_d in equation 2.3.8 – and equal to 0 if the child lives in any of the departments of the control sample. This variable measures the average permanent differences between treated and control samples. $After_t$ is a dummy variable equal to 1 if the child is observed and measured in the post-treatment period and equal to 0 if the child is observed and measured in the pre-treatment period – equivalent to λ_t in equation 2.3.8. This variable measures the common temporal trend of both the control and treated groups. The coefficient δ is the parameter of interest measuring the average effect of the rapid african palm expansion, and how it has been carried out, on all children living in Quetzaltenango and San Marcos. Because this study is not able to identify the specific population that is mainly affected by the treatment and, instead, considers as treated all children living in the departments where african palm has recently expanded rapidly, the coefficient δ corresponds to the *intention-to-treat* (ITT) effect.[13] Dummy variables at

[12] It is relevant to note that random assignment of the treatment ensures that the characteristics X_{it} are balanced across the treated and the control group. In this case, the simple comparison of potential nutritional status of children between groups would provide the average causal effect of the treatment. This usually happens with experimental data, and not with observational data, as the one that is used in this analysis.

[13] Ideally, the analysis should consider as treated the specific communities affected by the rapid expansion of african palm in south-west Guatemala. Since this information is not available, an alternative is to identify those municipalities

the department level, measured by the coefficient θ_d, account for the specific time-invariant characteristics of each department. β_t are dummy variables accounting for time trends common to all the departments. X'_{it} is the vector of covariates at the child, mother and household level. And ε_{idt} is the error term assumed of mean 0 and clustered at the household level.

A second solution that is also motivated by the CIA is the *propensity score matching* strategy (non-parametric estimation method), which mainly consists on matching children from the control group to children on the treated group that have similar conditional probability of assignment to the treatment, based on the distribution of the observable characteristics (Rosenbaum and Rubin, 1983). Both matching and regression are control strategies and differences between the estimates obtained are unlikely to be of empirical relevance (Angrist and Pischke, 2008). Due to this similarity, propensity score matching with difference-in-difference is performed in this study as a robustness strategy in order to verify the stability of the results obtained from regression analysis.

To explain this more precisely, lets come back to the previous notation but this time, for simplicity, the t subscript that relates to the pre and post treatment period are obviated. So, let Y_{1id} be the potential nutritional outcome of child i living in department d if the department is affected by the recently rapid expansion of african palm cultivation, and let Y_{0id} be the nutritional outcome of the child i living in department d if the department is not affected by the recently rapid expansion of african palm cultivation. Additionally, lets denote the treatment variable D_d as a dummy variable equal to 1 if the child lives in a department d that is affected by the treatment – Quetzaltenango and San Marcos – and equal to 0 in she/he lives in a department d that is not affected by the treatment - the rest of Guatemala not concerned by the african palm cultivation. The variables X_i that might help explain the selection of a child to receive the treatment are assumed to be known and observed.

Formally, the propensity score theorem states that, if the CIA holds so that potentional nutritional outcomes of the treated and non-treated children – Y_{1id} and Y_{0id}, respectively – are indepen-

in San Marcos and Quetzaltenango where african palm is currently cultivated. http://www.globalforestwatch.org enables to identify and map hectares with african palm trees, but only for seven countries: Brazil, Cambodia, Colombia, Indonesia, Liberia, Malaysia, and Peru. The National Agricultural Survey 2015 provides information at the municipality level of the number of hectares cultivated with african palm. However, the municipalities are only coded with a number and no additional information is provided, which does not enable to properly identify those with african palm crop. Alonso-Fradejas et al. (2011) provide detailed tables on the municipalities that are suitable for african palm cultivation as well as on the municipalities that were already cultivating the crop by 2010. This valuable information would enable to provide an analysis at the municipality level. Nontheless, the National Maternal and Children's Health Survey (ENSMI) for 1998/1999, 2002 and 2008/2009, do not have GPS data available that could help to properly identify the municipalities by department. Indeed, it seems that these three waves are representative at the municipality level but the specific variable only contains numbers by department which are not only different from the ones available in the GPS data of the ENSMI 2014/2015 but also do not have a label assigned to them. This difficults the estimation of the average treatment effect on the treated children (ATT) that an analysis at the municipality level might be able to provide. Further research should focus on using the available geographic information of the ENSMI 2014/2015 to provide a closer analysis.

dent of treatment assignment conditional on the observable characteristics X_i':

$$\{Y_{0id}, Y_{1id}\} \perp D_d | X_i \tag{2.3.10}$$

then, the potential nutritional outcomes are independent of treatment assignment conditional on a scalar function of these observable characteristics:

$$\{Y_{0id}, Y_{1id}\} \perp D_d | p(X_i) \tag{2.3.11}$$

where $p(X_i)$ is the propensity score defined as follows:

$$p(X_i) = E[D_d | X_i] = P[D_d = 1 | X_i] \tag{2.3.12}$$

In this sense, the propensity score corresponds then to the probability that a child lives in a department where african palm has recently expanded rapidly and thus received the treatment, conditional on the observable characteristics (Angrist and Pischke, 2008).

In practice, the estimation works in two steps. First, the propensity score $p(X_i)$ is estimated by regressing the dummy variable $Treat_d$ – equivalent to D_d – on the the vector of covariates X_{it}' using a probit model. Second, each child in the treated sample is matched with a child from the control sample with the closest value of the propensity score.[14] In the current analysis, propensity score matching is combined with difference-in-difference. That is, the matching is performed in both the pre-treatment and the post-treatment period. Once the treated and the non-treated children are matched, comparing their average nutritional outcomes in the post and pre-treatment period gives the first and the second difference, respectively, so that computing the difference-in-difference gives the intention-to-treat average effect of the treatment on children living in the treated departments.

One essential issue to consider when estimating the conditional probability of the treatment is that some children in the control sample could have observable characteristics that make the assignment of the treatment very unlikely, so that they would get a lower propensity score than any of the children in the treated sample, or even get a propensity score equal to zero – which is called *lack of common support* – (Ravallion, 2001). In order to assure that the comparison between potential nutritional outcomes is done over a common range of propensity scores – which is also called *common support* –, these observations need to be excluded from the group of control.[15]

In practice, the matching can be performed using different algorithms. In this analysis three types of matching are performed in order to improve the quality and test for further robustness. First, by imposing the common support restriction and matching each treated child with at least twenty of her/his *closest neighbours*, that is, twenty children belonging to the control group whose

[14] In stata this is performed using the command *psmatch2*.
[15] This can easily be done in stata by adding the option *common* available in the psmatch2 code.

observable characteristics are similarly distributed to those of the treated child.[16] In this case, the matching is performed with replacement, that is, each child in the control sample may be matched with more than one treated child. The second one imposes common support, twenty closest neighbours and a maximum tolerated propensity score *distance* (bandwidth or caliper) of 0.01.[17] Finally, the third and most improved matching, *kernel matching*, imposes common support, a maximum distance between matched children of 0.01, and gives larger weight to children in the control sample with smaller distances in terms of propensity score to the treated child they are matching with and lower weight to more distant observations (Caliendo and Kopeinig, 2008).

2.4 Data and Descriptive Statistics

As noted in the previous section, the goal of the current study is to analyse whether the treatment, defined as the recently rapid expansion of african palm crop (since 2010) and the means through which it has taken place – illegal dredging of rivers, the improper use of water resources and the purchase and forced dispossession of communal and family lands of the indigenous population –, has a significant impact in deteriorating nutritional outcomes of children under five in two departments of the south-west region of Guatemala.

To do this, the study uses survey data from the National Maternal and Children's Health Survey (ENSMI), which is carried out within the framework of the Demographic Health Survey (DHS) Program and the Reproductive Health Survey (RHS). The source where the data was withdrawn is the DHS Program and the International Household Survey Network. The national institutions that run the surveys are the Ministry of Public Health and Social Assistance (MSPAS) of Guatemala and the National Statistics Office (INE), with the financial and technical support from international cooperation agencies, governmental and non-governmental institutions such as UNICEF, the Institute of Nutrition of Central America and Panama (INCAP) and USAID, among others.

The purpose of the ENSMI is to collect information on the demographic situation of children's (under 5 years of age) health and the sexual and reproductive situation of women (15-64 years) and men (15-59 years) in Guatemala. The data is collected on a declarative basis and provides a large variety of information from more general topics, such as the socio-demographic characteristics of households (households composition, access to services, education, etc.), to more specific ones, such as fertility preferences, family planning, children's and women's nutrition and mortality, empowerment of women and violence against men and women. The data is a repeated cross-section with rounds between September and July. This means that the interviewed households in each wave are not the same but they are assumed to be representative of the national population via an individual weighting system, and thus comparable between waves. This study uses the waves of 1998/1999,

[16] The default matching method is single closest neighbour.
[17] 0.06 is the default option in the stata command psmatch2.

2002, 2008/2009 and 2014/2015, which are those that correspond to the period after the end of the civil war and the signing of peace agreements in 1996.

Since the treatment does not happen in but rather from a precise moment of time – 2010 – the pre-treatment period is defined by three time observations – 1998/1999, 2002 and 2008/2009 –, which allows to draw major trends of the potential predictors of child undernutrition between the group affected by the treatment and its comparison unit before the treatment took place. The post-treatment period is, thus, defined by one time observation – 2014/2015. The treated sample is composed of children that live in the departments of San Marcos and Quetzaltenango; hence, they are assumed to be affected by the rapid expansion of african palm and the ways in which it has been carried out. The control sample is composed of children that live in any other department of Guatemala, except for those where african palm is being grown. Furthermore, the analysis is restricted to children who are under five years of age and for which anthropometric data and information on the household and mother's aspects are available. The number of children in the treated sample is 2,776 and in the control sample is 18,712, which adds up to a total of 21,488 observations.

Table 2.4.1 summarises descriptive statistics of the main covariates included in the analysis[18], which provide information on household, mother and child's characteristics that may help explain the assignment of the treatment and are also assumed of having been fixed at the time the treatment took place. That is, they are not themselves outcome variables and, thus, they are considered to not be affected by the treatment. This is indeed a condition that Angrist and Pischke (2008) underline to be necessary for a variable to be a good control in order to increase the likelihood that regression estimates of equation 2.3.9 have a causal interpretation.

Since the analysis uses two methdologies (cf. previous section), the descriptives that are shown in table 2.4.1 characterise the samples of study for each of them. The unmatched sample concerns the one used for the difference-in-difference regression strategy – left side of table 2.4.1 – and the matched one corresponds to the sample analysed once the propensity score matching is applied – right side of table 2.4.1.[19]

The significance of the difference between group averages is provided in brackets. Table 2.4.1 shows that, on average and based on the observable characteristics, groups are significantly different in the unmatched sample, although these differences disappear when the matching is performed. The main statistically significant differences concern the level of education and the marital status of the mother, the area where the household lives, and the property of material assets that are a

[18]Please, refer to Appendix A for detailed information on these variables.

[19]The matching that has been perfomed uses common support, kernel matching and a maximum tolerated propensity score distance of 0.01. Estimation results from this matching are presented in part c) of table 2.6.2. This matching corresponds to the most improved one among the three that are performed in this study.

Table 2.4.1 – Summary statistics of the pre-treatment period: treated and control groups

	Unmatched Sample			**Matched Sample**		
Explicative variables	Treated	Control	Difference	Treated	Control	Difference
Household's characteristics						
Electricity, %	78.9	80.6	()	78.9	80.6	()
Refrigerator, %	21.3	28.7	(***)	21.3	20.6	()
Car, %	9.6	13.3	(***)	9.6	9.2	()
Telephone, %	8.3	13.6	(***)	8.3	8.6	()
Head of household: female, %	14.5	16.0	()	14.5	16.0	()
Urban, %	25.9	43.3	(***)	25.9	26.5	()
Mother's characteristics						
Age, years	25-29	25-29	()	25-29	25-29	()
Education, %						
-No education, preschool	25.2	28.6	(*)	25.2	28.1	()
-Primary	58.6	50.6	(***)	58.6	56.8	()
-Secondary	14.1	18.4	(***)	14.1	13.0	()
Marital status,%						
-Non union	7.2	2.8	(***)	7.2	3.7	()
-Married/with partner	91.2	92.3	(**)	91.2	91.9	()
-Widowed	1.1	1.0	()	1.1	1.0	()
-Divorced/separated	3.3	4.3	(*)	3.3	3.5	()
Indigenous, %	38.5	34.3	(**)	38.5	39.8	()
Wanted last child, situation	Wanted later	Wanted later	()	Wanted later	wanted later	()
Age at first birth, years	24.5	24.4	()	24.5	24.4	()
Child's characteristics						
Age, months	29.5	30.6	(**)	29.5	30.4	()
Gender: girl, %	49.6	50.0	()	49.6	50.0	()
Birth order, situation	3rd	3rd	()	3rd	3rd	()

	Pre-treatment			**Post-treatment**		
Dependent variables	Treated	Control	Difference	Treated	Control	Difference
Underweight, %	16.1	15.1	()	12.7	12.7	()
Stunting, %	52.4	49.1	(**)	52.8	45.6	(***)
Wasting, %	1.9	1.5	()	0.9	0.8	()
Observations Individuals	1,720	11,396	-	1,056	7,316	-
Observations Households	783	5,223	-	596	4,328	-

Notes: Matching is done using the propensity score matching with common support, kernel matching and a bandwidth of 0.01 (cf. Section 3 on empirical strategy and identification). Estimation results from this matching appear in part c) of table 2.6.2. *** p<0.01, ** p<0.05, * p<0.1.
Source: National Maternal and Children's Health Survey (ENSMI) 1998/1999, 2002, 2008/2009 and 2014/2015

proxy of the income of the household. Related to household characteristics, on average, the share of children that live in households that owns a refrigerator, a car or a telephone is larger in the control group (28.7% versus 21.3%) and 43.3% of the children in the former live in urban areas, whereas it is only 25.9% in the treated sample. Despite the significant difference across groups in the levels of education of the mother and her marital status, on average, 50% and 90% of the children, respectively, have mothers with primary education and who are married or living with her partner. Moreover, the share of children whose mothers identify themselves as indigenous is around 40% and higher in the treated sample, half of the children under five years old are girls, they are ranked third in the order of births from the same mother and are, on average, almost three years old.

The three outcomes in the table correspond to the three standard measures of undernutrition as defined by the World Health Organisation (De-Onis and Blossner, 1997): wasting (low height-for-weight), stunting (low height-for-age) and underweight (low weight-for-age).[20] Acute malnutrition and underweight have decreased over the period in both treated and control groups and respectively characterised 1% and 13% of the children in the sample. However, the percentage of stunted children in both groups is relatively high: around 50% of the children faced a situation of low height for their age during the pre-treatment period. Table 2.4.1 shows that this number has decreased in the control sample, whereas it has slightly increased in the treated one, as previously noted in table 2.3.1 from section 2.3. The difference in the average share of children stunted between treated and control sample seems to be significant in the pre-treatment period, justifying the empirical strategy of the analysis. The difference is, nonetheless, more significant in the post-treatment period and this analysis seeks then to understand to what extent this difference can be due to the rapidly recent expansion of african palm in the two departments of south-west Guatemala, and the means through which it has taken place.

2.5 Main Results and Heterogeneity Analysis

In this section, I present the main results from the estimation of equation 2.3.9 and I analyse the presence of heterogenous effects by considering differences between samples of population – rural vs. urban, indigneous mother vs. non-indigenous and whether the household head is a man or a woman.

Table 2.5.1 shows main results of the average intention-to-treat (ITT) effect of the recently rapid african palm crop expansion on the nutritional health of children under five in the two department of south-west Guatemala. Each column shows estimation of equation 2.3.9 for the three types of undernutrition that a child can experience – stunting (low heigh-for age), underweight (low weight-for-age) and wasting (low height-for-weight) – on the treatment, the pre/post period and the interaction of both terms (the ITT); on dummy variables at the department level as well as for each year in the analysis; and the covariates listed in table 2.4.1. Results from the analysis suggest

[20] Please, refer to the Appendix A for a detailed description of how these measures are calculated.

Table 2.5.1 – Main results of the diffrence-in-difference estimation - all nutritional outcomes

Variables	(1) Underweight	(2) Wasting	(3) Stunting	(4) Underweight3	(5) Wasting3	(6) Stunting3
ITT	0.000	-0.003	0.061***	0.008	-0.002	0.016
	(0.016)	(0.005)	(0.022)	(0.007)	(0.002)	(0.018)
Observations	21,488	21,488	21,488	21,488	21,488	21,488
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Department dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors grouped at household level in parentheses. Weighting is according to the weight of the household. Covariates include mother's education, mother's age, the order of the child within the total number of children the mother has, whether the mother wanted the child (then, after or wanted no more), the age of the mother at her first pregnancy, the marital status of the mother, the sex of the head of the family, access to electricity, ownership of refrigerator, car and telephone, mother is indigenous (or not), area (rural / urban), child's gender and child age (with a quadratic specification). Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median). Department dummies are binary variables for each department and time dummies are binary variables for each survey year. *** p<0.01, ** p<0.05, * p<0.1

that children under five years of age, living in San Marcos and Quetzaltenango – the departments affected by water pollution and the forced displacement of indigenous populations – are more likely to suffer from chronic malnutrition than those living in other departments of Guatemala where african palm is not cultivated - indeed, this probability increases by 6.1 percentage points (p.p.), on average. However, it does not seem to significantly increase the probability of suffering wasting or underweight.

Table 2.5.2 presents the average effect of the african palm crop expansion on chronic child malnutrition in south-west Guatemala and its heterogeneity by area, ethnicity and gender of the head of the household. Results in column 1 of table 2.5.2 corresponds to those in column 3 of table 2.5.1. Each of the other columns show the estimates from the same regression but for each sample according to the criteria of heterogeneity considered. Children with indigenous mohers seem to be the most negatively affected, since the probability of facing a situation of food and nutrition insecurity increases by 7.0 p.p.. Moreover, results suggest that the probability that children who live in the urban areas of San Marcos and Quetzaltenango suffer from chronic malnutrition increases by 15.2 p.p., with respect to those who live in urban areas in departments where african palm in not grown. Additionally, another result from table 2.5.2 reveals that children living in households where the head of the family is a man are those who are particularly affected, since the probability of presenting low height for their age increases by 7.6 p.p..[21]

[21] Results are the same when adding an interaction term instead of splitting the sample and they can be provided upon request.

Table 2.5.2 – Main results of the difference-in-difference estimation - heterogeneity analysis

Variables	(1) Stunting	(2) Stunting	(3) Stunting	(4) Stunting	(5) Stunting	(6) Stunting	(7) Stunting
ITT	0.061***						
	(0.022)						
ITT if urban area		0.152***					
		(0.037)					
ITT if rural area			0.013				
			(0.027)				
ITT if mother is indigenous				0.070**			
				(0.033)			
ITT if mother is not indigenous					0.062**		
					(0.030)		
ITT if household head female						-0.003	
						(0.054)	
ITT if household head male							0.076***
							(0.025)
Observations	21,488	7,690	13,798	8,180	13,308	3,739	17,749
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Department dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors grouped at household level in parentheses. Weighting is according to the weight of the household. Covariates include mother's education, mother's age, the order of the child within the total number of children the mother has, whether the mother wanted the child (then, after or wanted no more), the age of the mother at her first pregnancy, the marital status of the mother, the sex of the head of the family, access to electricity, ownership of refrigerator, car and telephone, mother is indigenous (or not), area (rural / urban), child's gender and child age (with a quadratic specification). Department dummies are binary variables for each department and time dummies are binary variables for each survey year. *** p<0.01, ** p<0.05, * p<0.1

These results provide evidence of the impact that the expansion of the african palm cultivation has on the established order within families and indigenous communities in the south-west region of Guatemala, which compromises the nutritional health of children under five years of age.

2.6 Robustness Checks

In this section, I check the results found in the previous section against four robustness tests in order to be able to draw conclusions from them.

To do this, I proceed to modify the control sample by restraining it to only consider children living in the other departments from the south-west region where african palm does not grow. Table 2.6.1 presents results from regressions of stunting on the treatment variable, the pre/post period variable, the interaction of both and the same covariates and dummies considered in the previous tables. Column 1 shows that the probability of children suffering from chronic malnutrition still increases significantly, on average, when they are exposed to the treatment, compared to children who live in neighboring departments within the same region. Further, results in columns 2, 4 and 7

Table 2.6.1 – Robustness checks: control group - departments from same region and without african palm

Variables	(1) Stunting	(2) Stunting	(3) Stunting	(4) Stunting	(5) Stunting	(6) Stunting	(7) Stunting
ITT	0.067**						
	(0.027)						
ITT if urban area		0.166***					
		(0.047)					
ITT if rural area			0.019				
			(0.032)				
ITT if mother is indigenous				0.061*			
				(0.036)			
ITT if mother is not indigenous					0.068		
					(0.043)		
ITT if household head female						0.056	
						(0.063)	
ITT if household head male							0.078***
							(0.030)
Observations	6,527	1,968	4,559	3,773	2,754	1,087	5,440
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Department dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors grouped at household level in parentheses. Weighting is according to the weight of the household. Covariates include mother's education, mother's age, the order of the child within the total number of children the mother has, whether the mother wanted the child (then, after or wanted no more), the age of the mother at her first pregnancy, the marital status of the mother, the sex of the head of the family, access to electricity, ownership of refrigerator, car and telephone, mother is indigenous (or not), area (rural / urban), child's gender and child age (with a quadratic specification). Department dummies are binary variables for each department and time dummies are binary variables for each survey year. *** p<0.01, ** p<0.05, * p<0.1

support that children particularly affected are those living in urban areas, with indigenous mothers and in families with a male head of the family, respectively. Moreover, coefficients remain quite stable. This suggests that the recently rapid expansion of african palm crop, that has been taking place in Quetzaltenango and San Marcos since 2010 and which has involved water pollution, forced population displacement and increased labour force within palm plantations, affects nutritional health of children under five not only when the treated group is compared to the corresponding cohort within the rest of the country but also when the comparison group is restrained to the same region where the affected children live.

The second robustness test consists on replicating estimations from table 2.5.2 using the *propensity score mathing*, detailed in section 2.3, as an alternative method to control for the potential differences among treated and control samples of children that may help explain the assignment of the treatment.

As explained in detail in section 2.3, this alternative estimation method identifies treated and

Table 2.6.2 – Robustness checks: propensity score matching

(a) PSM with at least 20 matches (closest neighbors)

Sample	**All**	**Urban**	**Rural**	**Indigenous**	**Non indigenous**	**Female head**	**Male head**
Variables	(1) Stunting	(2) Stunting	(3) Stunting	(4) Stunting	(5) Stunting	(6) Stunting	(7) Stunting
ITT	0.068***	0.150***	0.027	0.060*	0.042	-0.013	0.081***
	[0.002]	[0.000]	[0.300]	[0.062]	[0.133]	[0.802]	[0.001]
Observations	21,475	7,675	13,774	8,170	13,270	3,701	17,730
Bias before matching "Pre-treatment"	38.6	53.5	36.4	43.9	55.1	59.1	40.2
Bias after matching "Pre-treatment"	3.3	8.8	5.1	10.6	6.7	14.4	4.2
Pseudo R^2 before matching "Pre-treatment"	0.022	0.040	0.20	0.028	0.043	0.048	0.024
Pseudo R^2 after matching "Pre-treatment"	0.000	0.001	0.000	0.002	0.001	0.004	0.000

(b) PSM with at least 20 matches and smaller bandwidth (0.01)

Sample	**All**	**Urban**	**Rural**	**Indigenous**	**Non indigenous**	**Female head**	**Male head**
Variables	(1) Stunting	(2) Stunting	(3) Stunting	(4) Stunting	(5) Stunting	(6) Stunting	(7) Stunting
ITT	0.068***	0.153***	0.028	0.058*	0.039	-0.010	0.081***
	[0.002]	[0.000]	[0.292]	[0.074]	[0.165]	[0.848]	[0.001]
Observations	21,475	7,674	13,774	8,169	13,268	3,701	17,730
Bias before matching "Pre-treatment"	38.6	53.5	36.4	43.9	55.1	59.1	40.2
Bias after matching "Post-treatment"	3.3	8.9	5.0	10.9	6.5	15.4	4.3
Pseudo R^2 before matching "Pre-treatment"	0.022	0.040	0.020	0.028	0.043	0.048	0.024
Pseudo R^2 after matching "Pre-treatment"	0.000	0.001	0.000	0.002	0.001	0.004	0.000

(c) PSM with kernel matching and smaller bandwidth (0.01)

Sample	**All**	**Urban**	**Rural**	**Indigenous**	**Non indigenous**	**Female head**	**Male head**
Variables	(1) Stunting	(2) Stunting	(3) Stunting	(4) Stunting	(5) Stunting	(6) Stunting	(7) Stunting
ITT	0.064***	0.153***	0.030	0.069**	0.041	-0.005	0.078***
	[0.003]	[0.000]	[0.245]	[0.027]	[0.136]	[0.922]	[0.001]
Observations	21,475	7,675	13,774	8,170	13,270	3,701	17,730
Bias before matching "Pre-treatment"	38.6	53.5	36.4	43.9	55.1	59.1	40.2
Bias after matching "Pre-treatment"	10.6	12.9	10.0	12.6	8.8	12.5	10.6
Pseudo R^2 before matching "Pre-treatment"	0.022	0.040	0.020	0.028	0.043	0.048	0.024
Pseudo R^2 after matching "Pre-treatment"	0.002	0.003	0.002	0.003	0.001	0.003	0.002

Notes: p-value in brackets. Matching covariates are mother's education, mother's age, the order of the child within the total number of children the mother has, whether the mother wanted the child (then, after or wanted no more), the age of the mother at her first pregnancy, the marital status of the mother, the sex of the head of the family, access to electricity, ownership of refrigerator, car and telephone, mother is indigenous (or not), area (rural / urban), child's gender and child age (with a quadratic specification). *** p<0.01, ** p<0.05, * p<0.1.

non-treated children with similar propensity score, based on the distribution of the observed characteristics – household's, mother's and individual's – and, by doing so, enables to remove remaining confounding factors that might interfere in the estimation of the treatment effect. Results from the three types of matching algorithms used are presented in part a), b) and c) of table 2.6.2. The three types of matching are performed for the stunting outcome in the pre-treatment period (1998/1999, 2002 and 2008/2009) and the post-treatment period 2014/2015. Standard errors are obtained using bootstrapping methods and a number of tests have been carried out in order to assess the quality of the matching (Caliendo and Kopeinig, 2008). In particular, the tests that have been performed are: the percentage bias among covariates in the treated and control group, considering that matching should remove a large part of it – Rosenbaum and Rubin (1983) suggests that a standardized difference higher than 20 should be considered as large –; and the pseudo-R^2, which measures the extent to which the covariates explain the probability of receiving the treatment (Caliendo and Kopeinig, 2008) – if the propensity score balances covariates well, the covariates should be similarly distributed so they would not explain any more the probability to receive the treatment, and hence the pseudo-R^2 should be fairly low in the matched sample.

Results of these tests for the pre-treatment period are provided in the last rows of each part of table 2.6.2[22], from which it is possible to observe that the matching was very successful in reducing the percentage bias in the covariates. Indeed, the percentage bias before the matching was significantly high, whereas once each matching is performed, it reduces to not exceed the value of 12.9, suggesting that the technique seems to have produced a good balancing of the covariates in the sample. Additionally, the pseudo-R^2 test reveals that, after computing the matching, covariates explain a very low part of the likelihood of belonging to either group.

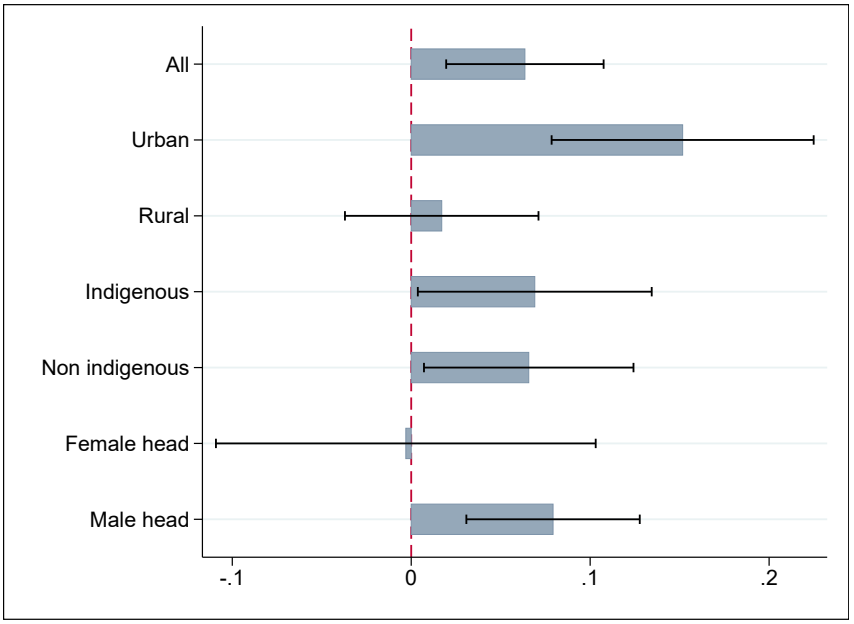
The drawback of this estimation method is that it does not enable to include dummies at the departments and at the year level, so results do not account for either the specific characteristics of each department or each year. Nontheless, coefficients from baseline results are still highly significant and stable when the matching is performed using any of the three algorithms. The substantial negative impact of the rapid expansion of african palm crop in the two departments of the south-west region of Guatemala seems robust in increasing the probability of urban children, with indigenous mothers, living in households with a male family head, to suffer from chronic malnutrition.

The third robustness check included in this analysis aims at testing whether the Storm Agatha, that took place in 2010 (at the same time as the rapid expansion of african palm in the south-west region) and that had a significant and sizable negative impact on household welfare (Baez et al., 2017), could represent a confunding factor on the main results obtained in the previous section.

[22]Balance tests for the post-treatment period provide similar results from the matching. They are not shown in this table but they can be provided upon request.

In May 2010, Guatemala was strongly hit by the tropical storm Agatha, which was considered as the 'strongest tropical storm ever to strike Guatemala since rainfall records have been kept' (Baez et al., 2017). The effects on household welfare were devastating: per capita consumption fell by 12.6% and poverty increased by 18%; food consumption was severely cut and expenditures on basic durables were reduced. The storm touched twenty out of twenty two departments, including the treated departments. Because the recent expansion of african palm crop in the south-west region of Guatemala started by the time this natural hazard took place, it is likely that the storm might have intensified the negative effect on child's nutritional outcomes, in which case baseline results would be overestimated.

Figure 2.6.1 – Robustness checks: storm agatha



Notes: bars are 95% confidence intervals from robust standard errors clustered at household level. Weighting is according to the weight of the household. Covariates include mother's education, mother's age, the order of the child within the total number of children the mother has, whether the mother wanted the child (then, after or wanted no more), the age of the mother at her first pregnancy, the marital status of the mother, the sex of the head of the family, access to electricity, ownership of refrigerator, car and telephone, mother is indigenous (or not), area (rural / urban), child's gender and child age (with a quadratic specification). Department dummies are binary variables for each department and time dummies are binary variables for each survey year.

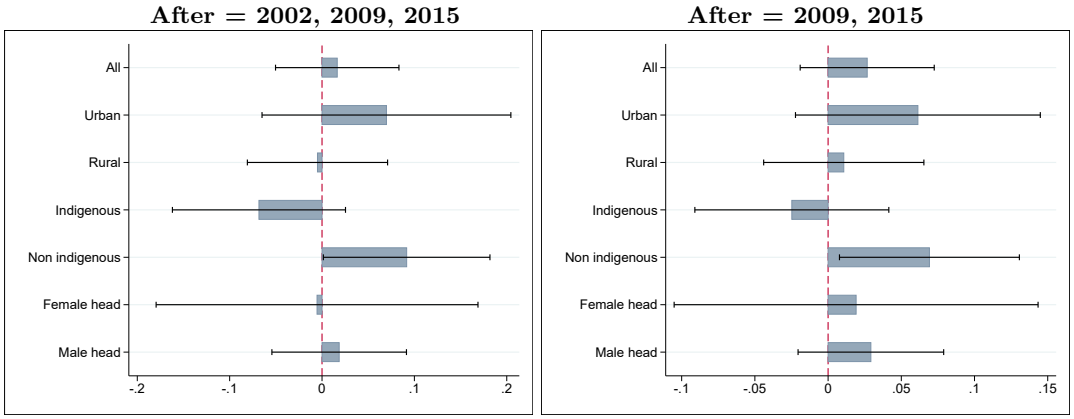
In order to dissipate these doubts, I introduce two additional covariates in the estimation equation: a dummy variable called $agatha_{id}$ equal to 1 if the child lives in the department hit by the storm (and 0 otherwise) and the interaction term between $agatha_{id}$ and $After_{it}$. This way, estimations control for the average effect of the storm Agatha on children living in the departments hit by the storm, compared to those that were not affected. Figure 2.6.1 shows that previous findings

are robust and coefficients are stable when controlling for the tropical storm.

In the fourth exercise, I try a falsification test where I modify the pre/post period assuming that the expansion of african palm in the south-west region took place a) after 1998 and b) after 2002. In a) the $After_{it}$ is a dummy variable equal to 1 if the child is observed and measured in 2002, 2008/2009 and 2014/2015 and equal to 0 if the child is observed and measured in 1998/1999. In b) the $After_{it}$ is a dummy variable equal to 1 if the child is observed and measured in 2008/2009 and 2014/2015 and equal to 0 if the child is observed and measured in 2002 and 1998/1999.

The main purpose of this robustness check is to assess whether, before the recent increase in the cultivated hectares with african palm and conditional on observable characteristics, there were significant differences in stunting outcomes between children living in the departments that will become affected by it – Quetzaltenango and San Marcos – and those that will not – the rest of the departments except from those where african palm is grown. Finding positive statistically significant coefficients would mean that the increase in the probability of children suffering from stunting in the treated departments is not due to the rapid expansion of the crop and the conditions through which it has taken place, but rather to something else. Results are presented in Figure 2.6.2.

Figure 2.6.2 – Robustness checks: time falsification tests



Notes: bars are 95% confidence intervals from robust standard errors clustered at household level. Weighting is according to the weight of the household. Covariates include mother's education, mother's age, the order of the child within the total number of children the mother has, whether the mother wanted the child (then, after or wanted no more), the age of the mother at her first pregnancy, the marital status of the mother, the sex of the head of the family, access to electricity, ownership of refrigerator, car and telephone, mother is indigenous (or not), area (rural / urban), child's gender and child age (with a quadratic specification). Department dummies are binary variables for each department and time dummies are binary variables for each survey year.

Both falsification tests show that coefficients are not statistically significant in any of the samples analysed except for those children with non-indigenous mothers, which shows that results shown

in column 5 of table 2.5.2 are not robust, reinforcing results concerning children with indigenous mothers. Therefore, it is possible to assert that the baseline results presented in column 3 of table 2.5.1 (and in column 1 of table 2.5.2) are specific to the rapid expansion of the african palm crop and how it has been carried out.

The last robustness check that I perform is the modification of the control group to only consider children living in departments that are suitable for african palm cultivation but where the crop has not yet expanded. Alonso-Fradejas et al. (2011) identifies four departments: Huehuetenango in the north-west, Zacapa in the north-east, Santa Rosa in the south-east and Retalhuleu in the south-west. The data portal Global Agro-Ecological Zones (GAEZ) from the Food and Agriculture Organization of the United Nations (FAO)[23], maps the suitable hectares for high, intermediate and low input level rain-fed oil palm. The departments that are identified are those from Alonso-Fradejas et al. (2011) and two additional: Chiquimula in the north-east and Jutiapa in the south-east. I use these six departments to build a control sample and I proceed to estimate previous regressions. Table 2.6.3 presents the results.

Column 1 shows that, although the coefficient and its significance are lower, the overall result is robust when comparing the average nutritional health of children living in San Marcos and Quetzaltenango with those living in departments that are suitable (but yet not used) for the cropping of african palm, before and after the treatment took place. Indeed, the probability of these children under five years of age of facing chronic malnutrition increases significantly by 4.1 p.p., on average. Column 2 shows that urban children are still those particularly affected, and the coefficient remains highly significant and quite close to the one found in table 2.5.2. Concerning the sex of the head of the household, results obtained in columns 6 and 7 show that children from families with a man at the head are still those with higher vulnerability of facing a situation of undernutrition than those living in a household led by a woman, although the coefficient and its significance are lower. Nonetheless, results concerning the ethnicity of the mother do not seem to be robust to this alternative specification of the control group.

All in all, the analysis of the present study is able to show that the increase in the cultivated hectares with african palm that is taking place since 2010 and has involved the destructuration of the established order within indigenous communities and has compromised the nutritional health of the most vulnerable members, has had a signifcant impact on deteriorating children's nutritional health in south-west Guatemala.

[23] http://www.gaez.fao.org/ calculates de Crop Suitability Index (SI) based on the average climate of a baseline period (1961-1990) and reflects the suitability levels and distributions within grid cells by classes based on SI values between 0 and 100.

Table 2.6.3 – Robustness checks: control group - suitable departments for african palm cultivation

Variables	(1) Stunting	(2) Stunting	(3) Stunting	(4) Stunting	(5) Stunting	(6) Stunting	(7) Stunting
ITT	0.041*						
	(0.024)						
ITT if urban area		0.144***					
		(0.044)					
ITT if rural area			-0.010				
			(0.029)				
ITT if mother is indigenous				0.032			
				(0.039)			
ITT if mother is not indigenous					0.049		
					(0.031)		
ITT if household head female						0.007	
						(0.059)	
ITT if household head male							0.051*
							(0.027)
Observations	10,244	2,504	7,740	2,899	7,345	1,721	8,523
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Department dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors grouped at household level in parentheses. Weighting is according to the weight of the household. Covariates include mother's education, mother's age, the order of the child within the total number of children the mother has, whether the mother wanted the child (then, after or wanted no more), the age of the mother at her first pregnancy, the marital status of the mother, the sex of the head of the family, access to electricity, ownership of refrigerator, car and telephone, mother is indigenous (or not), area (rural / urban), child's gender and child age (with a quadratic specification). Department dummies are binary variables for each department and time dummies are binary variables for each survey year. *** p<0.01, ** p<0.05, * p<0.1

2.7 Additional Analysis

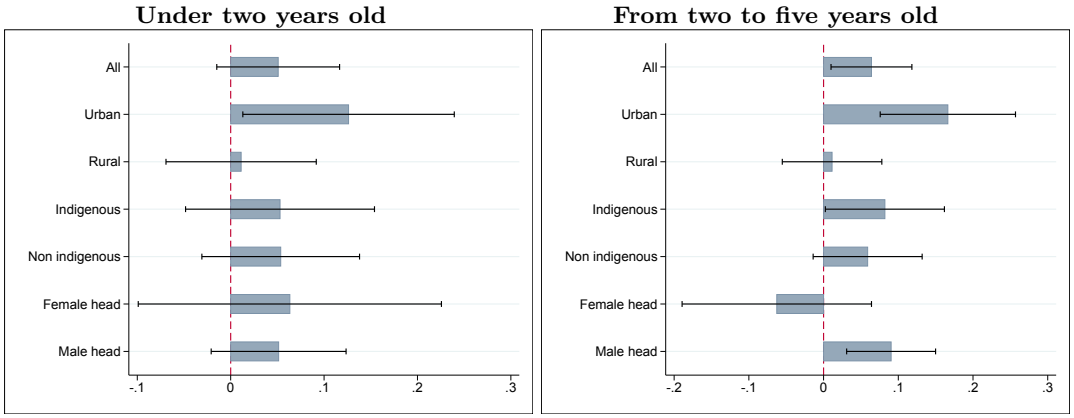
In this section, I present some additional analysis and statistics that might contribute to the understanding of the results found in this article.

For instance, it is noteworthy to understand why in this analysis, the impact of the recently rapid expansion of african palm in the south-west region of Guatemala on children's nutritional health, is manifested only in the anthropometric indicator of low height-for-age. Indeed, the first 1,000 days from the beggining of the pregnancy of the mother to the second birthday of the child are those when the child is growing more rapidly and requires higher nutritional intake, adequate health care, and a good environment to reach her/his full growth and development potential (Cashin and Oot, 2018). During this period, if their nutritional intake is deficient, children are most vulnerable to be stunted and face irreversible consequences such as increased risk of illness and death, delayed mental development, poor school perfomance and reduced intellectual capacity (WHO, 2010). In other words, the loss of growth and development of a child during these first 1,000 days are difficult to recover after the age of two (Cashin and Oot, 2018).

Since the treatment took place in 2010 and the survey that followed was in 2014/2015, children affected by the expansion of african palm in Quetzaltenango and San Marcos, might have faced deficient nutritional intake even before they were born, due to maternal undernutrition. If this is the case, and this situation was not reversed through improvement in their diet, these same children would most likely present an irreversible low height for their age when the survey took place in 2014/2015. Because anthropometric information is only available for children under five years of age, children surveyed in 2014/2015 had to be born, at least, around 2010 and, at last, around 2013. Consequently, the impact of the treatment would be most likely to be observed through an increase in the average of stunted children rather than in other growth indicator.

In order to check this, I proceed to estimate regressions from table 2.5.2 by age group, splitting the sample between under two year old children and children between two and five years old.

Figure 2.7.1 – Additional analysis: splitting the sample - children under two & from two to five

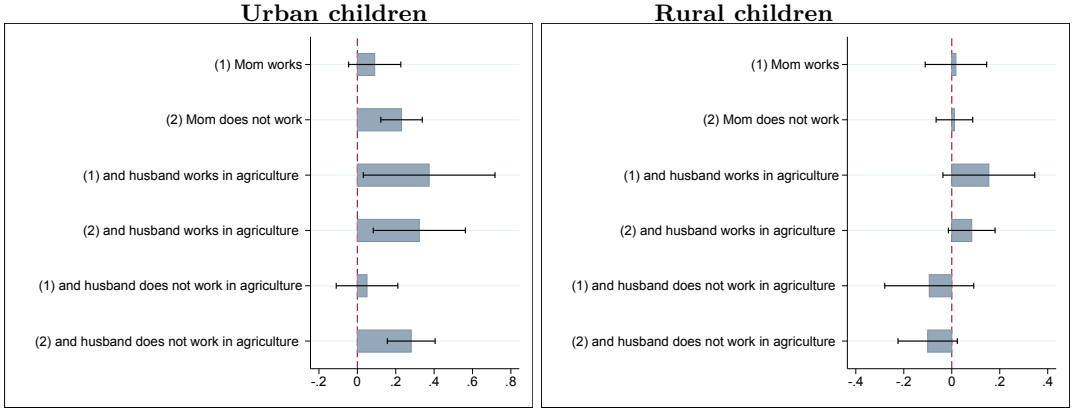


Notes: bars are 95% confidence intervals from robust standard errors clustered at household level. Weighting is according to the weight of the household. Covariates include mother's education, mother's age, the order of the child within the total number of children the mother has, whether the mother wanted the child (then, after or wanted no more), the age of the mother at her first pregnancy, the marital status of the mother, the sex of the head of the family, access to electricity, ownership of refrigerator, car and telephone, mother is indigenous (or not), area (rural / urban), child's gender and child age (with a quadratic specification). Department dummies are binary variables for each department and time dummies are binary variables for each survey year.

From figure 2.7.1, I observe that the results found throughout the paper mainly concern children between two and five years of age, which supports the explanation here above. Children living in urban areas seem to be affected indistinctively of their age, although the coefficient for children under two year old is only significant at the 5% confidence level. Therefore, it seems fair to consider, that the rapid expansion of african palm in that is taking place in Quetzaltenango and San Marcos since 2010, particularly contributed to a deficient nutritional intake of children that were born between 2010 and 2013, increasing their probability of being irreversibly stunted after the age of two.

Other results that are worth to discuss are whether other variables related to children's growth could be affected by the rapid expansion of african palm crop in Quetzaltenango and San Marcos; why urban children are the ones most negatively affected, rather than rural children; and why children living in households with a male at the head are also those whose probability of suffering low height for their age increase significantly. The challenge with this additional analysis is that some useful information such as child's birth weight, the body mass index of the mother, the access to vitamin A intake by the child, the access to land used for agriculture or whether the household has ran out of food in the last 30 days preceeding the survey, are either not available for at least one of the two main years (2008/2009 for the pre-treatment period and 2014/2015 for the post-treatment period), or some information is available but the questions asked in the survey and the coding do not enable to build a homogenous variable for at least these two main years.[24]

Figure 2.7.2 – Additional descriptive results: splitting the sample - urban and rural children



Notes: bars are 95% confidence intervals from robust standard errors clustered at household level. Weighting is according to the weight of the household. Covariates include mother's education, mother's age, the order of the child within the total number of children the mother has, whether the mother wanted the child (then, after or wanted no more), the age of the mother at her first pregnancy, the marital status of the mother, the sex of the head of the family, access to electricity, ownership of refrigerator, car and telephone, mother is indigenous (or not), area (rural / urban), child's gender and child age (with a quadratic specification). Department dummies are binary variables for each department and time dummies are binary variables for each survey year.

Two dummy variables that I am able to build from the available information are whether the

[24] For instance, birth weight and mother's body mass index are available for the wave of 2014/2015 and 1998/1999 but not for 2008/2009 and 2002; the intake of vitamin A and the lack of food during the 30 days preceeding the survey (this last variable has also a very small recall time) are only available for the wave of 2014/2015 and the access to arable land is asked as 'household owns land usable for agriculture' in 2014/2015 but in 2008/2009 the question that is first asked is 'does your partner works mainly in agriculture?' and if the answer is yes, then the question is 'in which type of land does he work?'. When using this information to create a unique variable for both main years, numbers resulted in a surprisingly high increase in the access to land in the treated and the control groups, which does not correspond to what is found in the context of Guatemala and seems to indicate that this information can't be used to build a homogenous variable.

mother of the child works – equal to 1 and 0 otherwise – and whether her partner works in agriculture (self-employed) – equal to 1 and 0 otherwise. Because these variables are only available for the year 2008/2009 in the pre-treatment period and the year 2014/2015 in the post-treatment period, I use them to provide additional results from a descriptive point of view, in relation to the difference in the impact of the expansion of african palm crop among children living in urban and rural areas. It is noteworthy to highlight from section 2.2, that a plausible explanation to this result is the migration of the affected families from rural to urban areas, which implies their relocation in a more precarious way (Hurtado, 2008); or the migration of women, in search for a complementary job that allows them to complete family income (Castro et al., 2015). A very useful online data portal with available information from census microdata on the migration status of the individual is IPUMS International.[25] However, the last available data for Guatemala is for the year 2002, which does not enable to draw current statistics on the subject. Consequently, I proceed to use the two variables that I describe above and estimate equation 2.3.9 for stunting among urban and rural children.

Figure 2.7.2 presents descriptive results for children living in urban areas and in rural areas, conditional on the mother working at the time of the interview and her partner being self-employed in agriculture. The first observation is that children living in urban, and not rural, areas present a significant increase in the probability of being stunted when they live in the departments affected by the rapid expansion of african palm crop, as noted throughout the last two sections. The first two bars ((1) and (2)) suggest that, among urban children, those whose mother does not work are the ones that seem to be particularly affected. In the third and the fourth bars, it is noted that when the mother's partner works in agriculture, children are more likely to suffer chronic malnutrition, and the significance is higher when the mother of the child does not work either. These results might correspond to subsistance families, cultivating their own crops. However, the highest statistically significance of an increase in the probability of children being stunted when they live in the two affected departments, is shown in the last bar, which concerns urban children whose mother does not work and her partner is not self-employed in agriculture.

To better understand these last descriptive results, the survey of 2014/2015 provides additional information of the husband/partner's occupation. Almost 40% of children live in households where the partner of the mother is self-employed in agriculture and the occupations that follow are skilled manual (27.4%) and sales (9%). One could think that cultivating their own crops, provides the family with a source of food which might be more difficult to access through the market, even when other jobs might report some income to the household. Cultural practices and power relationships within the family could also play a role. Indeed, during times of food scarcity, women and children are sometimes forced to reduce their nutritional intake in favour of other members of the households (SIDA, 2015). Taking into consideration the context of Guatemala, one could think that when the

[25] https://international.ipums.org/international/

only source of income in the household comes from work done by the male household head, he could be considered a priority in the access to available food, making children whose mother does not work and with no access to staple food through their own family production, more vulnerable to have a deficient nutritional intake. Furthermore, in line with evidence from previous studies analysing the relationship between mother's work and child care in Guatemala[26], migration from rural to urban areas tends to push women away from family protection and access to informal child care givers, which could increase their vulnerability within this context.

Finally, the national living standards survey (ENCOVI) of 2014, provides information on which municipality the respondent lived in 2009. The drawback is that there is no available information on the municipality where the respondent currently lives, but the information is available at the department level. Checking this data, I observe that the highest percentage of the population currently living in the neighbour department to Quetzaltenango and San Marcos where african palm is not cultivated by 2015, Retalhuleu, used to live in 2009 in the municipalities of Ayutla (San Marcos) – 21.03% –, Coatepeque (Quetzaltenango) – 19.82% and Ocós (San Marcos) – 8.43%. These municipalities are identified by Alonso-Fradejas et al. (2011) as those where african palm was being cultivated in 2010. The population who used to live in Ocós claim to have emigrated for marriage reasons, those who used to live in Coatepeque justify their migration with housing and services reasons and those who used to live in Ayutla – the municipality with the highest number of hectares cultivated with african palm (Alonso-Fradejas et al., 2011) – state that the main reason they emigrated for was violence. Although individuals interviewed in this survey might not be those from the DHS used in this article, this descriptive information might just provide some useful statistical evidence about the difficulties encountered by the population living in the municipalities of Quetzaltenango and San Marcos where african palm crop has rapidly expanded since 2010.

2.8 Conclusions

This study analyses the impact of african palm crop expansion on child undernutrition in Guatemala. Results have shown that the bad practices of this expansion in two departments of the south-west region have had a significant and negative impact on the nutritional health of children under five years of age during the last decade. Using a difference-in-differences identification strategy to assess the average intetion-to-treat effect, results show that children under five years of age, living in San Marcos and Quetzaltenango - the departments affected by water pollution and the forced displacement of indigenous populations - are more likely to suffer from chronic malnutrition than those living in other departments of Guatemala where african palm is not cultivated - indeed, this probability increases by 6.1 percentage points, on average. However, it does not seem to significantly increase the probability of suffering wasting or underweight. This might be due to the lag of time between the treatment took place and the implementation of the survey. Indeed, additional

[26] See Hallman et al. (2005) for a review.

analysis suggest that children between two and five years of age are those particularly affected, since a deficient nutritional intake during the first two years of life increases the vulnerability of children of facing irreversible low height for thir age.

The heterogeneity analysis shows that the effect particularly concerns children from indigenous mothers (7.0 p.p.), living in urban areas (15.2 p.p.) and in households where the head of the family is a man (7.6 p.p.). These results are robust when the control sample only considers children living in the other departments from the south-west region where african palm does not grow; when applying matching techniques to reduce heterogeneity among samples; when controlling for the tropical storm Agatha that frapped Guatemala by 2010; when doing falsication tests by modifying the pre/post period; and when modifying the control group to just consider departments that are suitable for african palm cultivation but where the crop was not yet expanded by 2010.

Despite this study is focused on the social impact, it is noteworthy to underline that the negative impact has also been environmental and, thus, economic. Since other parts of Guatemala are currently being damaged by the aggressive expansion of african palm crop – such as those in the northen region of Petén and the lowlands of northern Guatemala –, it is difficult to quantify the potential long-term impact that these practices will have on the economic and sustainable development of the country. Nonetheless, public policies which operate at the local level and involve the protection of the most vulnerable population can be particularly effective in preventing child malnutrition from increasing.

Appendix

2.A Description of Variables

2.A.1 Variables on Undernutrition

Malnutrition may appear in the form of undernutrition or overweight (De-Onis and Blossner, 1997). This study focuses on undernutrition and its major types that are:

- Acute malnutrition (wasting/low weight-for-height): wasting indicates, in most cases, a recent and serious risk of weight loss, that is most frequently associated with acute hunger and/or serious disease. Nonetheless, wasting can also be the result of chronic unfavorable conditions.
- Chronic malnutrition (stunting/low height-for-age): low height-for-age reflects a process of inability to reach a linear growth potential as a result of suboptimal health and/or nutritional conditions. At the population base, high levels of stunting are associated with bad socioeconomic conditions and a higher risk of frequent and sooner exposure to adverse conditions, like diseases and/or inadequate feed practices.
- Underweight (combine stunting and wasting/ low weight-for-age): low weight-for-age reflects low body mass in relation to the chronologic age of the child, and it is influenced by both the height of the child (height-for-age) and his/her weight (weight-for-height). This indicator fails to distinguish between short children of adequate body weight and tall, thin children. Nonetheless, in the absence of significant wasting within a community, similar information is provided by weight-for-age and height-for-age, in that both reflect the long-term health and nutritional experience of the individual or population.

The way to identify whether a child from birth to five years of age faces any of the three types of malnutrition is through her/his anthropometric measurement (weight-for-age, height-for-age and weight-for-height). According to these measures, a z-score is calculated, which is used to compare the results from the child to those from the accepted international reference population's median value calculated by the World Health Organisation (WHO) and which is sex-specific. If the z-score is below minus two standard deviations from the median of the reference population, the child can

be either classified with low weight-for-height (wasted), low height-for-age (stunted) and low weight-for-age (underweight). If the z-score is below minus three standard deviations from the median of the reference population, the child is classified as severely wasted, stunted or underweight.

2.A.2 Variables on the Child, Mother and Household's Characteristics

Child's characteristics

- Birth order: binary variable for the order of the child within the total number of children the mother has.
- Age: age of child in months.
- Girl: binary variable equal to 1 if the child is a girl, and 0 if the child is a boy.

Monther's characteristics

- Education: binary variables for no education/preschool, primary, secondary and higher education
- Age: age of the mother in years.
- Wanted the child: binary variables for whether the mother wanted the child then, wanted later or did not want the child.
- Age at her first pregnancy: age of the mother when she got first pregnant in years.
- Marital status: binary variable for the marital status of the mother, which can be without union, with partner/married, widowed and divorced/separated.
- Ethnicity: binary variable equal to 1 if the mother is indigenous, and 0 otherwise.

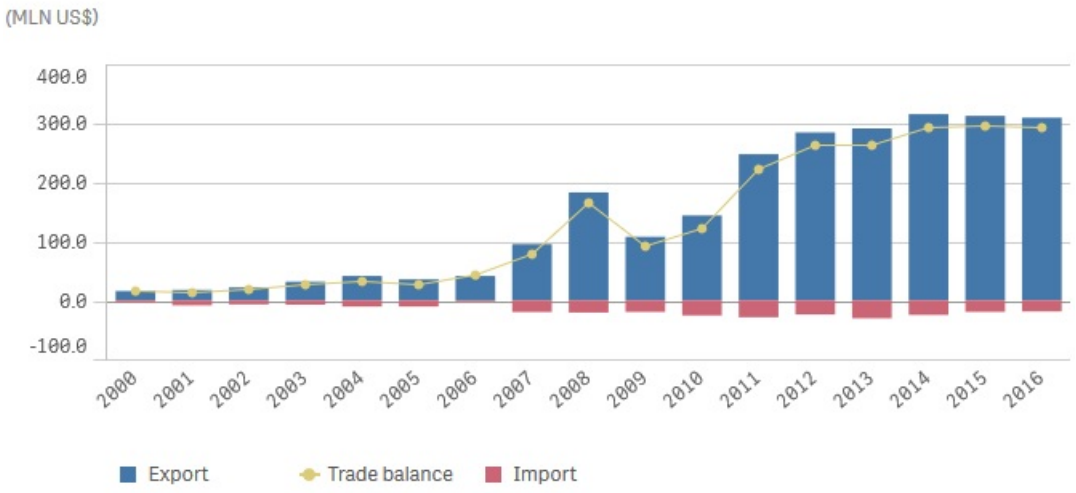
Household's characteristics

- Female household head: binary variable equal to 1 if the head of the household is female, and 0 if the head of the household is male.
- Access to electricity: binary variable equal to 1 if the household has access to electricity, and 0 otherwise.
- Ownership of refrigerator: binary variable equal to 1 if the household owns a refrigerator, and 0 otherwise.
- Ownership of car: binary variable equal to 1 if the household owns a car, and 0 otherwise.
- Ownership of telephone: binary variable equal to 1 if the household owns a telephone, and 0 otherwise.

- Urban: binary variable equal to 1 if the household lives in urban area, and 0 if the household lives in rural are.

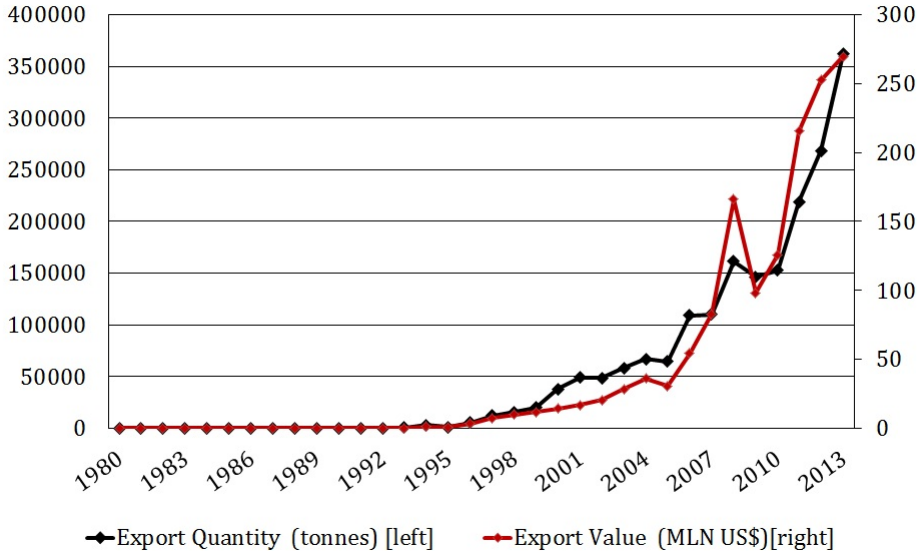
2.B Trade Balance of Palm Oil

Figure 2.B.1 – Trade Balance of palm oil



Source: UN Comtrade

Figure 2.B.2 – Palm Oil Exports. Quantities and value



Source: UN Comtrade and FAO

Chapter 3

It Takes a Village to Raise a Child. Women's Education, Mother's Knowledge and Child Undernutrition in Indigenous Guatemala

3.1 Introduction

We are still far from a world without malnutrition. Indeed, different forms of malnutrition coexist in many countries. On the one hand, after a prolonged decline, the number of hungry people in the world is growing. On the other hand, overweight and obesity are becoming a serious concern, also in developing countries (FAO, 2018). In a time where food availability, quality and security are at risk, children are paying the higher price. Undernutrition is still the most prevalent form of malnutrition among children. According to UNICEF, in 2017, 151 million kids under five were

The views presented in this Chapter are those of the authors and do not necessarily reflect those of the Foundation FUNDAP.

We are deeply thankful to Antoine Terracol, one anonymous reviewer, participants at the internal research seminar of Oxford Poverty and Human Development Initiative (OPHI) from the University of Oxford, and participants at the 31st Conference of the European Association of Labour Economist, for valuable comments and suggestions; and all the staff working in the Foundation FUNDAP, and particularly Magali García and Eunice Martínez, that implements the program "Volunteers in Health" for giving us the opportunity to collaborate with them in evaluating the impact of their program on children's nutritional health in West Guatemala, as well as for the help that they have provided us throughout the analysis and that has allowed us to get closer to the reality of Guatemala.

stunted, while 51 million suffered from wasting.[1]

Nearly two out of five stunted children live in South Asia, while one in three lives in sub-Saharan Africa. Latin America and the Caribbean have percentages of stunted children which are far behind the South Asian and sub-Saharan African levels[2], with a unique exception: Guatemala. Guatemala is the only country in the American continent where the percentage of stunted children is higher than 30%. Indeed, 46.5% of Guatemalan children under five are chronically undernourished and 12.6% suffer from global undernutrition (MSPAS and INE and Segeplán, 2017). It is well known that undernutrition, especially in early years, may result in higher susceptibility to illnesses and potential loss in intellectual quotient, which may translate in lower cognitive skills and productivity in adult years (Imai et al., 2014).

Despite the huge incidence of undernutrition among Guatemalan children, there is no robust evidence of its determinants, effects and possible solutions. To the best of our knowledge, only two works have attempted to face this issue in this country. One focuses on the determinants of undernutrition in general, the other on the possible consequences of a diet poor in proteins and vitamins. Marini and Gragnolati (2003) simply describe the relationship between child, maternal, household and community characteristics and children's nutritional status. Using data from the ENCOVI/INE 2000 survey and standard multivariate regression techniques, they show a strong association between children undernutrition, among which stunting prevails, and socioeconomic, geographical and ethnic factors. They found that undernutrition in Guatemala is concentrated among the poor, the least educated households, the rural population, and indigenous people. According to them, actions to face undernutrition in this country should focus on the areas of health, access to basic services, education, and nutritional interventions. In particular, they underline the relevance of community-based programs. Maluccio et al. (2009), instead, used a more robust approach to study the effect of an early childhood nutritional intervention on adult economic outcomes. On the basis of an intent-to-treat model, they found that the intervention, which consisted in the random provision of nutritional supplements to children, had long lasting positive effects in terms of higher grades, higher scores in both reading and comprehension tests and non-verbal cognitive ability tests.

According to these findings, a lack of appropriate nutritional knowledge and micro-nutrients availability for infants and young children are key determinants of child undernutrition, with long lasting consequences. We are able to provide new evidence on the relevance of nutritional education and food supplementation for kids in Guatemala thanks to the availability of unique information on a program aiming at improving mothers' knowledge on feeding practices and child health, together with the provision of food and vitamins supplements. The program, implemented since 2001 by the Foundation FUNDAP, targets the most vulnerable inhabitants of the country: the indigenous

[1] https://data.unicef.org/topic/nutrition/malnutrition/

[2] 9.6% on average, versus, respectively, 35% and 34% (UNICEF and WHO and World Bank, 2018)

population living in the poorest Western regions. These are the areas where chronic and global undernutrition reach respectively 40% and 80% of children under five years of age.

What is also relevant is that the program operates at the community level. Individuals living in the village who have at least a primary level of education are encouraged to follow a full-time course in infant nutrition and basic nursing in order to become a qualified "Volunteer in Health" able to sustain mothers during the first years of life of the child, usually becoming the closest reference mothers have to help them raise their children. Indeed, after having completed the training, passed exams and acquired official diplomas, these volunteers start to provide supports through a program called nutritional recovery cycles. During 6 months, once per-month, they visit mothers, give them guidance on how to feed their children, provide food and vitamin supplements and perform basic measurements to verify the growth process of the child. Despite being open to both men and women, the volunteers are in large majority female. Acquiring this specific knowledge and being able to transmit it to mothers results in potential empowerment of women in this critical area of the country, where ignorance about fertility, birth control methods, hygiene and nutrition is still high.

In order to evaluate the effect of the program and, specifically, the nutritional recovery cycles, we proceed in two steps. In the first one, we focus on the population of children visited by the volunteers from 2015 to 2018 to provide evidence on how children improve their nutritional health outcomes as the recovery cycle goes on. The outcomes of interest are the standard measures defined by the World Health Organization (WHO) of child undernutrition in terms of z-scores (stunting, wasting, underweight).[3] We also estimate the average effect of participating in a nutritional recovery cycle, controlling for children's time-invariant unobserved characteristics. In a second step, we rely on additional data from the last National Maternal and Children's Health Survey[4] of 2014/2015. This allows us to build a reliable control group of children living in municipalities close to the treated ones, but who are not under the program. Specifically, we compare health outcomes of children who were monitored by volunteers in health in 2015 with those of children who lived in close municipalities where volunteers did not operate.

Our main results suggest that after two visits from the beginning of the recovery cycle, the probability of a child to be underweight significantly drops, and in the last visit she/he receives by the volunteers this probability is 21 percentage points (p.p.) lower with respect to the timing in which he/she was first measured, on average. Moreover, when controlling for age, time trends, and individual time-invariant unobserved heterogeneity, we find that completing a nutritional recovery cycle reduces the probability of being (severe) underweight by 8.9 p.p. (4.6 p.p.) and wasted by

[3] Please, refer to Appendix A for a detailed description of these measures.

[4] Encuesta Nacional de Salud Materno Infantil (ENSMI), which is comparable to the Demographic and Health Survey.

3.8 p.p., on average. Additionally, when controlling for a large set of observable characteristics that allow us to mitigate concerns of selection bias, the results from the analysis done for the year 2015 using a control group as counterfactual, suggest that the program was significantly effective in reducing underweight among treated children. More precisely, we find that the probability that a child between 10 and 59 months of age suffered from underweight in 2015, was significantly reduced by 23.6 p.p. when she/he participated to the nutritional recovery cycle. These results are robust to several specifications and a falsification test.

Our paper belongs to the stream of literature analyzing the relationship between mothers' knowledge and child outcomes in developing countries. Most of this literature focused on the role played by general education on children's health. Glewwe (1999) found that, in Morocco, schooling plays a fundamental role for mothers since it indirectly allows them to be able to get health knowledge, which, in turn, is the most important skill that mothers have to take care of their children's health. Chou et al. (2010), instead, studied the effect of a general increase in mothers' education on child health. They evaluated a policy intervention which took place in Taiwan in 1968 and extended compulsory education from 6 to 9 years and opened over 150 new junior schools at a differential rate among regions. They found that mothers' schooling causes favorable infant health outcomes. An increase in schooling lowers the probability that an infant will be born light or will die in the neonatal or post-neonatal periods. Imai et al. (2014) found that increasing mothers' education relative to fathers is associated with better nutritional status of children in rural India.

There is much less evidence of the effect of specific knowledge on infant feeding and children's health, a gap in the literature that we contribute to fill. An example similar to ours is by Fitzsimons et al. (2016), who studied a program aimed at providing information on child nutrition to mothers is rural Malawi. Also in this case, trained local women visited mothers both before and after the birth of the child and provided information on infant feeding. They found evidence of improvements in children's diet and household food consumption, in particular an increase of protein-rich foods and fruits and vegetables. These improvements lead to children's better physical growth. To the extent of the current study, we are not able to distinguish the specific impact of each of the components of the nutritional recovery cycle – transfer of knowledge on nutritional health to mothers, monitoring of children's growth and supply of vitamin supplements. Following the experience of the coordinator of these programs at the Foundation FUNDAP, the most important factor in the process of nutritional recovery is the education and the support the mother receives. If she puts into practice the information received, she will provide the child with the corresponding dose of vitamins and improve care practices. This, in turn, will significantly help the child gain weight and height, breaking the vicious circles of disease. In line with this, other studies such as Paes-Sousa and Santos (2009), Gertler (2004) and an analysis from the National Department of Planning in Colombia (Rojas et al., 2007), have analyzed the impact of conditional cash transfer (CCT) pro-

grams in Brazil, Mexico and Colombia, respectively, on children's health indicators.[5] Although they all have found that these programs seem to be effective in improving children's nutritional health, they are not able to disentangle the effect of each of the components: budget improvement, parental education on nutrition, nutritional supplements and growth monitoring. Nonetheless, the sinergy between a larger supply of health facilities, the change in dietary patterns and the additional cash to poor families might underline the results found (Cecchini and Soares, 2015).

The structure of the paper is as follows. Section 3.2 is dedicated to the description of the training program and the main characteristics of the "Volunteers in Health". In section 3.3 we present the data and the descriptive statistics of the children from the complete available sample, as well as from the sample used for the analysis. Section 3.4 shows the empirical strategy, while section 3.5 presents the main results obtained from the analysis. In section 3.6 we report some robustness checks and section 3.7 concludes.

3.2 The Training of Volunteers in Health

This section is dedicated to the description of the training program and the main characteristics of its participants.

3.2.1 Purpose and Structure of the Training

The program "Volunteers in Health" has been implemented since 2001[6] by the Foundation FUNDAP. The motivations behind its development were twofold. First, the high rates of maternal and infant morbidity and mortality in Guatemala.[7] Second, the need to respond to the poor coverage of health services and lack of qualified staff at the community level. To partially solve both concerns, the Foundation FUNDAP designed a vocational capacity building program aimed at training qualified figures in the areas of fertility, pregnancy, child care, and nutritional counseling within communities. It additionally provides knowledge on birth control and hygiene at the individual and household levels.[8]

The program is currently implemented in rural and urban communities of the departments located in the North-West and South-West regions of Guatemala: Huehuetenango, Quetzaltenango, Retalhuleu, San Marcos, Sololá, Suchitepéquez and Totonicapán.[9] The communities where the

[5] Please, refer to Table 3.C.1 in Appendix C for more detailed information on these studies

[6] Unfortunately, reliable collection of data only started in 2015.

[7] In the early 2000*s*, the under-five years of age mortality rate was 50 deaths per 1,000 live births (UNICEF, 2013).

[8] Moreover, given the critical situation that Guatamala is facing in terms of agricultural production and climate changes, it recently started to give information on sustainable consumption and community development.

[9] Please, refer to Appendix B for a description of some characteristics of the departments. The program "Volunteers in Health" is not implemented in the department of Quiché since the Foundation FUNDAP does not have trained staff in that region. Nonetheless, qualified staff within the Foundation is in charge of monitoring children in severe

program is implemented respond to three requirements: there is a sufficient number of people interested in enrolling the program; interested people fulfill basic educational requirements; and the acceptance of the program implementation by the mayor of the community. If these requirements are met, interested potential participants must follow a 12 hours course on the purpose and structure of the program. After this course, official enrollments are made. The training consists of a total of 134 hours over 11 months. The first 120 hours are dedicated to formal classes[10], while the remaining 14 hours are dedicated to case analyses, visits to health institutions, and practice in medical centers. At the end of the training program, participants must take written examinations and get official diplomas.

After obtaining the diploma, volunteers start to provide their counseling services within the communities. These services may take different forms, from awareness campaigns on health at the community level, to domestic visits to mothers and children in case of need. For the purpose of this work we will focus on a specific service: the nutritional recovery cycles. These are programs aimed at monitoring and supporting children's growth process. Each cycle lasts 6 months. During this period of time, children are visited once per month by volunteers, who, in addition to giving mothers nutritional and health guidelines, also provide a food and vitamins supplement called *"Incaparina"*. Incaparina consists of the mixture of a cereal and a legume (corn and soy flour) to obtain an adequate balance of essential amino acids. It is also reinforced with a scientifically developed micro-nutrient mixture of vitamins[11] and minerals.[12] During the 6 months period of the nutritional recovery cycle, mothers are given the equivalent of 3 portions of 120ml of Incaparina per day and per child as an additional source of food for their children who enter the nutritional recovery cycle.[13] So far, the doses are the same, for children in conditions of severe and moderate under-nutrition. Moreover, children's height and weight are monitored at each visit.

3.2.2 Volunteers in Health: Main Characteristics

We have information on "Volunteers in Health" from 2015 to 2017. Table 3.2.1 shows descriptive statistics on their main characteristics: average age, percentage of volunteers by marital status, by occupation and by departments, as well as the exact number of volunteers per year of enrollment. All these characteristics are presented making a distinction between female and male volunteers.

health conditions in the area. Therefore, and since we have nutritional information on children that live in some municipalities of Quiché, we include this department in the analysis, as well as in the detailed description of the departments.

[10]The most relevant topics of formal classes are: women's health, fertility, pregnancy and pregnancy-related complications, labor and delivery, newborn care, mothers and children's nutrition, most common diseases in children, hygiene, community health, and prevention and mitigation of natural disasters.

[11]Vitamin A, B1, B2, B12, D.

[12]Folic acid, niacin, iron, zinc, and calcium.

[13]The nutritional supplements are assigned by children and not by family. If there are two children in the nutritional recovery cycle, each one will receive 3 portions of 120ml of Incaparina per day.

Table 3.2.1 – Summary Statistics: Volunteers in Health

	(1) Women	(2) Men
Age, years	28.3	30.2
Marital Status		
Married/Cohabiting, %	43.5	36.9
Separated/Divorced, %	1.0	0.4
Single, %	55.0	62.7
Widow, %	0.5	0.0
Occupation		
Housewife, %	55.0	0.0
Student, %	19.9	31.6
Dealer, %	3.0	10.7
Farmer, %	0.1	18.3
Others, %	21.9	39.5
Department		
Huehuetenango, %	3.8	9.9
Quetzaltenango, %	33.8	25.5
Retalhuleu, %	14.5	11.4
San Marcos, %	21.2	21.7
Sololá, %	0.6	0.0
Suchitepequez, %	10.0	9.9
Totonicapán, %	16.1	21.7
2015	899	89
2016	755	89
2017	846	85
Observations	2500	263

Source: statistics produced from the raw data available from the Foundation FUNDAP.

The number of individuals participating in the program has decreased over time, from 988 in 2015 to 931 in 2017. The large majority of participants, around 90%, are female. The average age of women is 28 years old, while that of men is 30. Most of volunteers are single: 55% of women and 63% of men. A larger share of females is in a couple, such as married or cohabiting, 43% versus 37% of males. The fraction of separated/divorced or widow is extremely low, especially among men. The large majority of women, around 60%, is a housewife. The proportion of men enrolled in any kind of studies is larger (32%) than that of women (20%). Men are also well represented among farmers (19%) and dealers (11%). We also observe that the departments with the highest

share of "Volunteers in Health" are Quetzaltenango, San Marcos and Totonicapán. The smallest percentage of volunteers is located in the department of Sololá and they have not reached yet the department of Quiché.

Table 3.2.2 – Educational attainment of female volunteers in health as compared to average women in Guatemala

	(1) Female Volunteers	(2) Guatemalan Women
No school %	4.97	18.40
Primary incomplete	8.48	19.50
Primary complete %	18.40	16.60
Technical incomplete %	6.12	16.20
Technical complete %	27.36	20.80
Secondary incomplete %	8.68	3.40
Secondary complete	21.04	5.10
University incomplete %	4.24	.
University complete %	0.72	.

Source: statistics on female volunteers is produced from the raw data available from the Foundation FUNDAP and on Guatemalan women from the National Institute of Statistics (Instituto Nacional de Estadística).

Table 3.2.2 shows the shares of female volunteers by educational attainment as compared to the average educational levels of women in Guatemala. This is to show how women participating to the program have, on average, a higher level of education than average women in Guatemala, and aim to acquire additional specific education through the participation to the training program. In an area where the share of illiterate individuals is still high[14], this represents a good signal on how this program is also helping women to acquire more education, one of the main indicators of female empowerment.

3.3 The Recovery Cycle Program: Descriptives

The purpose of our analysis is to evaluate the impact that the "Volunteers in Health" program and the nutritional recovery cycle service provided by the trained volunteers, have on the nutritional health of children in the West regions of Guatemala. To do this, we use two samples of study: a first one consisting of all the children monitored by the volunteers between 2015 and 2018, and a second one which is a sub-sample of treated children and includes information on children from a control group.

[14] see Appendix B for more details

In this section, we provide descriptive information on the full sample of children participating in the nutritional recovery cycle as well as on the sub-sample of treated and control children used for the second analysis.

3.3.1 Full Sample of Children Participating in the Nutritional Recovery Cycle

The data used in the first analysis, which has been provided by the Foundation FUNDAP, is full information on the anthropometric measurements of children under five years of age that the volunteers have monitored from 2015 to 2018. Table 3.3.1 reports the most relevant characteristics of these children. They are aged between 5 and 58 months and are 25.8 months on average, that is, two years and 2 months. The percentage of girls is higher than that of boys, 66.3%. Around 80% of children in the sample are stunted, 46.1% severely, while around 48% are underweight.

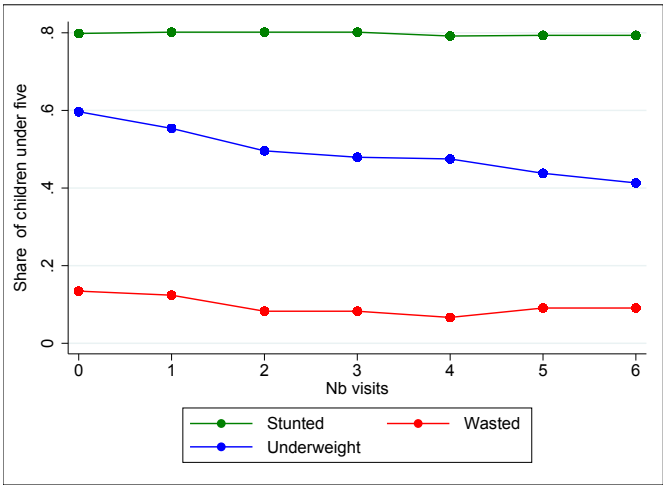
Table 3.3.1 – Descriptives on the full sample of children in the nutritional recovery cycle program, 2015 - 2018

	(1) Mean	(2) SD	(3) Min	(4) Max
Age, months	25.8	11.9	5	58
Female,%	66.3	0.5	0	1
Nb visits	4.1	3.5	0	20
Weight, kgs	9.4	2.0	4.5	15.9
Height, cms	77.7	8.0	56	97
Underweight, %	47.9	0.5	0	1
Stunting, %	79.5	0.4	0	1
Wasting, %	9.1	0.3	0	1
Severe underweight, %	15.4	0.4	0	1
Severe stunting, %	46.1	0.5	0	1
Severe wasting, %	2.6	0.3	0	1
Observations		982		

Source: statistics produced from the raw data available from the Foundation FUNDAP.

In Figure 3.3.1 we present the share of children who are stunted, underweight and wasted within one nutritional recovery cycle, which, we recall, lasts 6 months, with one visit per month. We observe that the share of children that suffer from underweight tends to decrease throughout the cycle, which already suggests that the program seems to alleviate this specific form of undernutrition. In fact, the share of underweight children decreases from 60% when they enter the program to 40% at its end.

Figure 3.3.1 – Share of children who are stunted, wasted and underweight throughout one nutritional recovery cycle



Source: statistics produced from the raw data available from the Foundation FUNDAP.

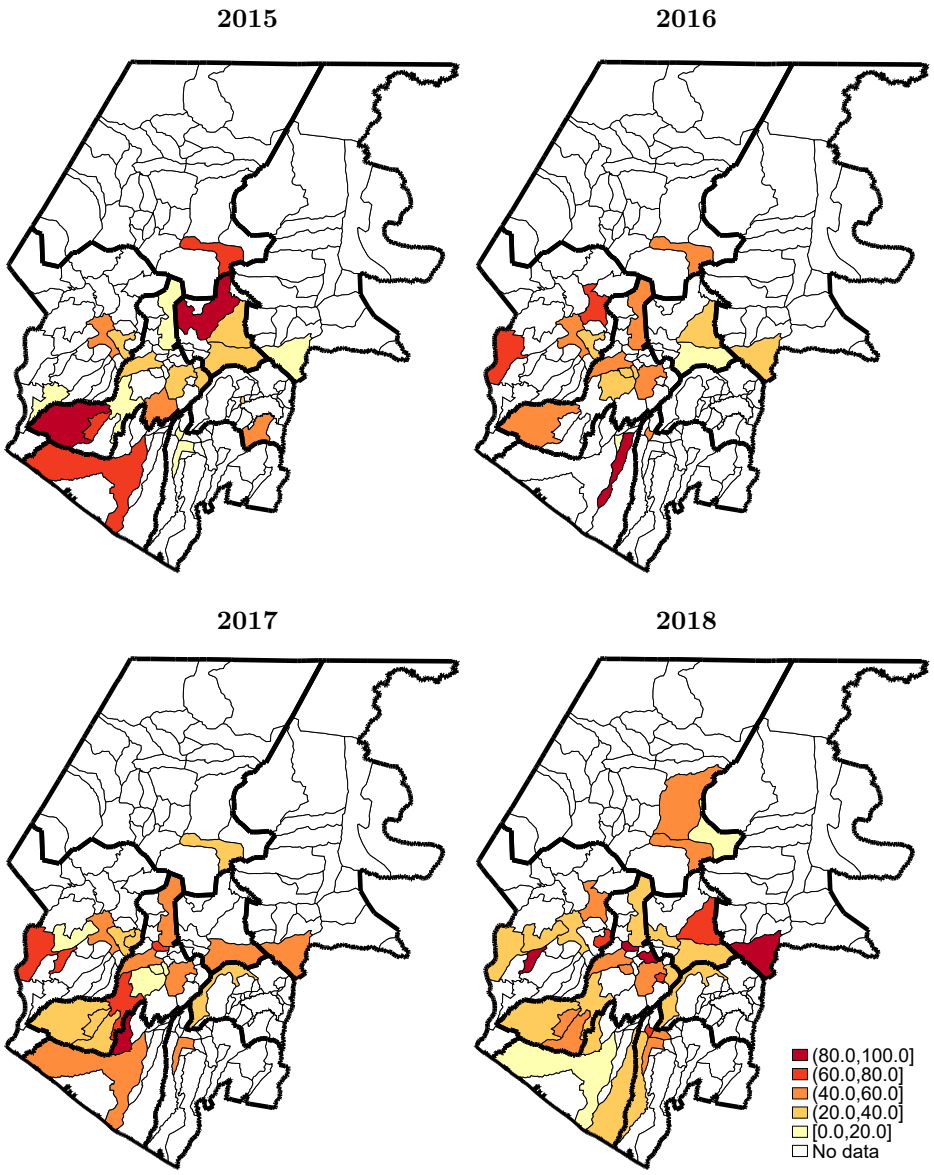
In Figure 3.3.2 we represent the share of children monitored by the Volunteers in Health that suffer from low weight for their age, by municipalities and departments from 2015 until 2018.

We observe that the number of municipalities in which the Volunteers in Health work has increased during this period of time. The departments of Quetzaltenango and Retalhuleu are those were the volunteers are more present, whereas the departments of Huehuetenango, Quiché, Sololá and Suchitepéquez are those where volunteers reach less. At the same time, we can observe that in some municipalities such as those in the South of Quetzaltenango (municipality of Coatepeque and Flores Costa Cuca), in the North of Totonicapán (municipality of Momostenango), in the West-Center of Retalhuleu (municipality of Retalhuleu) and in the South of Huehuetenango (municipality of Huehuetenango), the share of children that suffered from underweight in 2015 attained between 60% to 100% of the total number of children that were monitored. Nonetheless, we note that these percentages have reduced significantly until representing between 0% to 20% of the children monitored in 2018. These observations give further anecdotal evidence on the relevance that the program has on the nutritional health of the children under five years of age in West Guatemala.

3.3.2 Sub-Sample of Children: Treated and Control Groups

In order to improve the evaluation of the "Volunteers in Health" program and the service on nutritional recovery cycles they provide, we need to rely on additional sources of data. Since there is no information on children that were not treated by the Volunteers in Health, we use the National Maternal and Children's Health Survey (ENSMI) 2014/2015 to build a reliable control group, which

Figure 3.3.2 – Share of children under five monitored by the Volunteers in Health with low weight-for-age



Source: statistics produced from the raw data available from the Foundation FUNDAP.

we use as comparison.

As already said, data on the treated sample is available for 2015, 2016, 2017 and 2018. On the other hand, data on the control sample is available for 2014 and 2015. We focus our analysis on 2015 since this is the only common year for which we have data on both groups. We also focus the main analysis on the North-West and South-West areas of Guatemala, since these are the areas where the Foundation FUNDAP is currently reaching. The treated sample is composed of children that have entered the program on nutritional recovery cycles – and thus have been monitored by Volunteers in Health – and for which we have full anthropometric data and information on household characteristics.[15] The control sample is composed of children from the same departments that live in municipalities where Volunteers in Health do not reach. Therefore, children in the control group are not monitored by them.[16] Furthermore, we restrict the analysis to children who fall within the same age range, which is between 10 and 59 months.

Table 3.3.2 – Summary Statistics: treated and control groups

Explicative variables	**Treated**	**Control**	**Difference**
Household's characteristics			
Improved sanitation, %	47.5	86.8	(***)
Access to drinking water, %	78.1	69.8	(**)
Ownership of animals, %	80.3	64.8	(***)
Good quality of housing materials, %	2.9	56.4	(***)
Child's characteristics			
Age, months	31.9	33.5	()
Gender: girl, %	56.2	48.1	(*)
Ever vaccinated, %	91.2	91.0	()
Dependent variables			
Underweight, %	35.0	16.0	(***)
Stunting, %	80.3	64.0	(***)
Wasting, %	3.7	0.5	(***)
Observations	137	1,549	

Notes: *** p<0.01, ** p<0.05, * p<0.1.
Source: statistics produced from the raw data available from the Foundation FUNDAP and in the last National Maternal and Children's Health Survey (ENSMI) 2014/2015.

We end up with a treated group of 137 children and a control group of 1,549. Table 3.3.2 summarises descriptive statistics for the main variables used in the analysis[17] and gives information

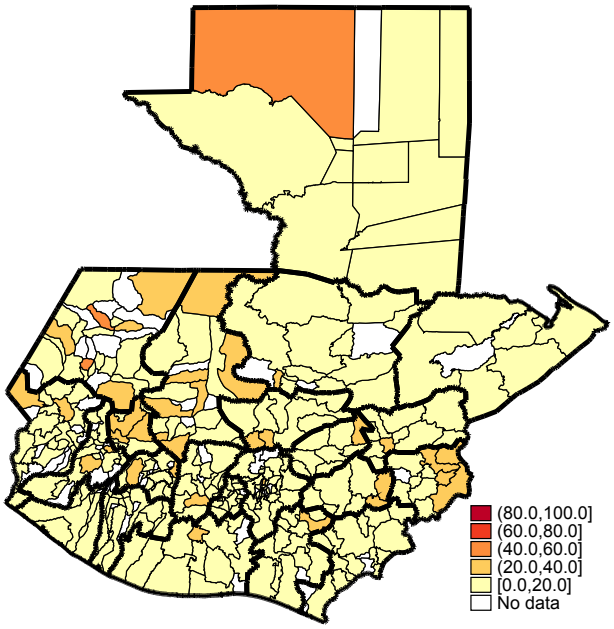
[15] This information is the one provided in Table 3.3.2

[16] We have proceeded as such because in the survey data we don't have information on whether children entered or not the nutritional recovery cycle and, thus, we are not confident on their treatment status. However, we know in which municipalities of the North-West and South-West regions the volunteers do not work and these are the ones (as long as survey data is available) that are included in the control group.

[17] Please, refer to Appendix A for detailed information on these variables. Information on the ethnic origins of the mother are not available in the data from the Foundation FUNDAP and we are not able to proceed with this

on the significance of the difference between group averages. We note that, on average and based on the observable characteristics, groups are significantly different with the exception to the share of children that have ever been vaccinated, which reaches 92% of the children in the sample, as well as the average age of children in the sample, that is two years and a half. Related to household characteristics, we observe that, on average, the share of the population that has access to improved sanitation[18] is larger in the control group (86.8% versus 47.5%), whereas the treated group enjoys more availability to safe drinking water (78.1% versus 69.8%) and ownership of animals (80.3% versus 64.8%), on average. Also, the share of girls is slightly larger in the treated sample (56.2%) than in the control one (48.1%).

Figure 3.3.3 – Share of children under five with low weight-for-age in 2014/15 in Guatemala



Source: statistics produced from the raw data available in the last National Maternal and Children's Health Survey (ENSMI) 2014/2015.

The three outcomes in Table 3.3.2 correspond to the standard measures of undernutrition as defined by the World Health Organisation (WHO, 2010) and De-Onis and Blossner (1997): wasting (low height-for-weight), stunting (low height-for-age) and underweight (low weight-for-age).[19] Their values for the treated sample correspond to those calculated from the last measurement done by the volunteers. We use this measure and not the first one in order to make sure that all children

identification by the type of animals they have. Information on the area (rural/urban) where the child lives is also not available.

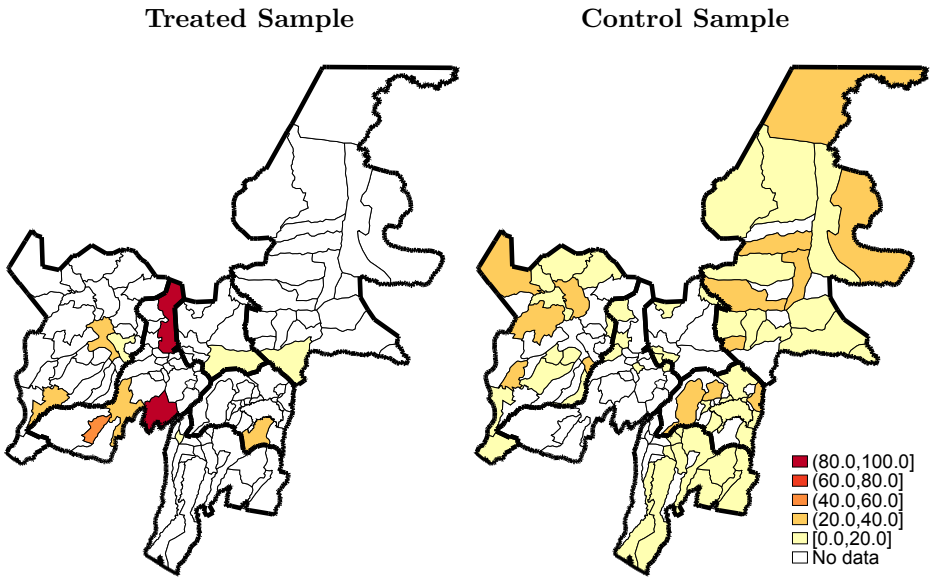
[18]Improved sanitation facilities, improved drinking water sources and good dwelling are coded following the Millenium Development Goals Guidelines (United Nations, 2009b).

[19]Please, refer to the Appendix A for a detailed description of how these measures are calculated.

have received the treatment at least once, regardless of the number of times she or he has received it.[20] We observe that, on average, the share of children between 10 and 59 months that face a situation of undernutrition, as measured either by low weight-for-age, low height-for-age or low height-for-weight, is significantly larger in the treated sample than in the control group.

Figure 3.3.3 shows the share of children under five suffering from underweight (or global malnutrition) in all Guatemala. In order to be able to provide figures at the national level, the data used for this map is entirely from the ENSMI 2014/15 survey. As previously stated, the highest shares of prevalence are found in the West-North and West-South regions, where most of the indigenous people live. In these regions, the rate of children facing low weight for their age reaches 40 to 60% in some municipalities, compared to the rest of the country where the average share is not higher than 40% (except from a municipality in the region of Petén in the North).

Figure 3.3.4 – Share of children 10-59 months with low weight-for-age in 2015 in West Guatemala



Source: statistics produced from the raw data available from the Foundation FUNDAP and in the last National Maternal and Children's Health Survey (ENSMI) 2014/2015.

In Figure 3.3.4 we map the share of children between 10 and 59 months who suffered from low weight-for-age in 2015 in the treated and the control municipalities within the 6 departments of analysis. In this case, the data used for these figures is the one used in the analysis – i.e., the data in the treated sample comes from the Foundation FUNDAP and the data in the control sample from the ENSMI 2014/15 survey. The number of treated municipalities is 13, whereas the control municipalities are 63. We observe that in some municipalities of the treated group 80% to almost

[20]The treatment is here considered to be at least one visit from the volunteers.

all children followed by the Volunteers in Health faced a situation of underweight in 2015.

3.4 Empirical Strategy and Identification

Our empirical strategy is divided into two different parts. We begin by performing two exercises on the full sample of treated children from 2015 to 2018 to estimate, first, the evolution of the probability of being (severely) stunted, (severely) underweight and (severely) wasted by visit received by the volunteers within a full recovery cycle; and second, its average when children have completed a full recovery cycle, compared to that when the cycle is not yet completed.

We then move to a different approach, consisting in selecting a sub-sample of treated children and building a reliable control group to provide an evaluation of the effectiveness of the nutritional recovery cycle program in fighting infant undernutrition among the poorest indigenous areas of Western Guatemala.

3.4.1 Part 1: Analysis on the Full Sample of Treated Children

We begin our analysis by studying the evolution of the probability of being (severely) stunted, (severely) wasted or (severely) underweight at each visit that makes up a nutritional recovery cycle. More specifically, for each treated child, we indicate as $v = 0$ the first time he/she is visited by the volunteer, who evaluates his/her health status and decides that the child enters the nutritional recovery program. Afterwards, the child will be monitored by the volunteer, who will also provide the mother with the required dosage of Incaparina and the necessary information to take care of the infant's nutritional needs, once per month during 6 months until the cycle is completed.

We estimate a linear probability model for child i, measured by the volunteer at visit v in year t, specified as follows:

$$Y_{ivt} = \sum_{j=1}^{6} \gamma_j \cdot \mathbf{1}[j = v] + \sum_{k} \alpha_k \cdot \mathbf{1}[k = age_{it}] + \sum_{s} \nu_s \cdot \mathbf{1}[s = t] + \varepsilon_{ivt} \tag{3.4.1}$$

where Y_{ivt} is a binary variable equal to 1 if the child suffers from (severe) stunting, (severe) wasting or (severe) underweight at visit v in year t, and 0 otherwise; v (first term of the right-hand side) are binary variables for each visit the child has received; and binary variables for the age (in years) of the child (second term) and for the year in which the child is measured by the volunteer (third term), are included. ε_{ivt} is the error term assumed of mean 0 and clustered at the child level. Estimations of the probability of begin stunted, underweight or wasted are done relative to the time in which the child is monitored for the first time and enters the program – i.e., relative to the first visit $v = 0$. Including age dummies in the regression allows us to control for common age

trends, while the year dummies account for common time trends.

To deepen the analysis, we seek to measure the average probability of being (severely) stunted, (severely) wasted or (severely) underweight when the child has completed a full recovery cycle, compared to that when the cycle is not completed. In this specification, we restrict our analysis to the sample of children who have completed just one nutritional recovery cycle – i.e., children who have been visited more than six times, likely because of poor initial health conditions, but who have not completed a second recovery cycle. As a robustness check we extend the sample to include also those children that have completed two cycles.

We estimate a linear probability model for child i, measured by the volunteer at visit v in year t, specified as follows:

$$Y_{ivt} = \nu_t + \theta_i + \delta T_{iv} + X'_{it}\zeta + \varepsilon_{ivt} \tag{3.4.2}$$

where Y_{ivt} is a binary variable equal to 1 if the child suffers from (severe) stunting, (severe) wasting or (severe) underweight at visit v in year t, and 0 otherwise; X'_{it} is a set of covariates that include the age of the child (in years) with a quadratic specification; ν_t are year fixed effects, accounting for common time trends to all children measured in the same year; and θ_i are individual fixed effects, measuring the time-invariant unobservable characteristics at the child level. T_{iv} is a binary variable equal to 1 if the child i has been monitored at least seven times by the volunteers (the first, and then six more within the recovery cycle), and hence has completed at least one recovery cycle, and 0 otherwise. ε_{ivt} is the error term assumed of mean 0 and clustered at the child level. The coefficient δ is the parameter of interest, measuring the average probability of being stunted, wasted or underweight when a child has completed a full recovery cycle, compared to that when the cycle is not yet completed.

3.4.2 Part 2: Analysis on the Sub-Sample of Children in the Treated and Control Groups

As we have indicated previously, the goal of this second analysis is to analyse whether the program of "Volunteers in Health" and the service on nutritional recovery cycles the volunteers provide, has a significant impact in improving nutritional outcomes of children under five in West Guatemala. In order to do this, one would think that the simplest way to do it is to compare the health status of those children who have received the treatment – i.e., who have been monitored by the volunteers – with the health of those who have not – i.e., the control sample. As we have seen in the previous section, the average prevalence of underweight in the treated municipalities is 19 percentage points (p.p.) higher than in the control ones and this difference is statistically significant at 1% confidence level. Proceeding with this naive comparison might make us conclude that the program of the Foundation FUNDAP make children sicker. However, we should not take this result as granted

since what this comparison might be telling us is that children monitored by the volunteers are probably less healthy, on average. Indeed, even after having received the treatment at least once, children might still be suffering from under-nutrition, although they might be better off than they would have been if they hadn't received the treatment.

This information suggest that the assignment of the treatment is not random, or said in other words, that the treatment is not independent of the health status of children. This creates a problem of selection bias (Angrist and Pischke, 2008). To describe it more precisely, we denote the variable measuring the treatment each child i receives from the volunteers in health as D_i, which is equal to 1 if the child receives the treatment and 0 otherwise (i.e., children in the treated sample receive a value of 1 and those in the control group receive a value equal to 0). The outcomes of interest, which are the different measures of undernutrition as defined by the WHO ((severe) wasting, (severe) stunting and (severe) underweight), are denoted as Y_i. If the child suffers from any kind of undernutrition, Y_i is equal to 1 and 0 otherwise. Therefore, the question is whether D_i has an impact on Y_i or not.

Ideally, one would like to compare the potential health status of child i if she/he is monitored by the volunteers, Y_{1i}, with her/his health potential status had she/he not been monitored by them, Y_{0i}. This last potential outcome is called the counterfactual and gives information on what the health status of a treated child i would be if she/he had not received the treatment. The difference between the two potential outcomes, $Y_{1i} - Y_{0i}$ is said to be the causal effect of the program "Volunteers in Health". Unfortunately, we can never see both potential outcomes for any child and, thus, we need to rely on the comparison of the average health of those children that received the treatment and those that did not, in order to learn about the impact of the program implemented by the Foundation FUNDAP.

However, we have seen few lines above that this naive comparison provides us with poor information about the effect of the program as long as the assignment of the treatment is not independent of the health status of children. Formally, the observed difference in average nutritional status conditional on being monitored by the volunteers in health can be written as follows:

$$\underbrace{E[Y_i|D_i=1] - E[Y_i|D_i=0]}_{\text{Observed difference in average health}} = \underbrace{E[Y_{1i}|D_i=1] - E[Y_{0i}|D_i=1]}_{\text{ATT}} + \underbrace{E[Y_{0i}|D_i=1] - E[Y_{0i}|D_i=0]}_{\text{Selection bias}} \tag{3.4.3}$$

where the first term on the right side of the equation is called the *average treatment effect on the treated (ATT)*, or in other words, the *average causal effect of the program "Volunteers in Health" on those children who were followed and treated by the volunteers*, which indeed measures the difference between the two potential outcomes of child i; and the second term on the right side of the equation

is the *selection bias*, which measures the difference in average nutritional outcome between those who were treated by the volunteers in health and those who were not. As we have seen in table 3.3.2, this difference is significantly large and positive – 19 p.p. – and it might mask the effect of the program, which we would expect to reduce the probability of children being undernourished, thus a significant negative coefficient.

When the treatment D_i is randomly assigned, Angrist and Pischke (2008) suggest that the selection bias term disappears making the treated and control groups comparable. In this case, a simple regression of Y_i on D_i would thus give the *average causal effect of the program 'Volunteers in Health" on those children who were followed and treated by the volunteers.* Nonetheless, when this is not the case, it is important to include in the regression (of Y_i on D_i) a variety of control variables X_i that could help explain the difference in nutritional outcomes between treated and non-treated children. That is, to account for those relevant observable variables that could help explain what causes a child to enter the nutritional recovery cycle and therefore be treated by the volunteers.

This leads us to the *Conditional Independence Assumption* (CIA) or what it is also called *selection on observables* because these variables X_i that might help explain the *selection of a child to receive the treatment* are assumed to be known and observed (Angrist and Pischke, 2008). The CIA is a core assumption that tells us that, conditional on the observed characteristics X_i, the selection bias disappears and hence, the comparison of average nutritional outcomes across treated and non-treated children has a causal interpretation. Formally, the CIA can be written as:

$$\{Y_{0i}, Y_{1i}\} \perp D_i | X_i \tag{3.4.4}$$

which means that, conditional on the observable variables X_i, the potential nutritional outcomes of treated and non-treated children are independent of the treatment assignment and, thus, both groups can be indeed compared[21]. If the CIA holds, equation 3.4.3 can be re-written as follows:

$$\underbrace{E[Y_i|X_i, D_i = 1] - E[Y_i|X_i, D_i = 0]}_{\text{Observed difference in average health}} = \underbrace{E[Y_{1i} - Y_{0i}|X_i]}_{\text{ATT}} \tag{3.4.5}$$

and comparing potential average nutritional outcomes between treated and non-treated children, conditional on the observable characteristics, gives us the average treatment effect of the program "Volunteers in Health" on those children who were followed and treated by the volunteers.

Because the treatment assignment happens in this study at the municipality level (cf. previous

[21] It is relevant to note that random assignment of the treatment ensures that the characteristics X_i are balanced across the treated and the control group. In this case, the simple comparison of potential nutritional status of children between groups would provide the average causal effect of the program. This usually happens with experimental data, and not with observational data, as the one that is used in this analysis.

section), the regression that we estimate is a linear probability model[22] for the child i that lives in department d, measured at time t and is specified as follows:

$$Y_{idt} = \alpha_d + \gamma_t + \underbrace{\beta}_{ATT} Treatment_{id} + X_i'\zeta + \varepsilon_{idt} \tag{3.4.6}$$

where Y_{idt} is a binary variable equal to 1 if the child suffers from (severe) stunting, (severe) wasting or (severe) underweight and 0 otherwise. $Treatment_i$ is a dummy variable equal to 1 if the child i living in department d is monitored by the volunteers in health and equal to 0 if the child lives in the same department but in a municipality where the volunteers don't reach, thus he is not monitored by the volunteers. The coefficient β measures the average treatment effect of the program on the treated children (ATT). We include dummy variables at the department level, measured by the coefficient α_d, accounting for the specific time-invariant characteristics of each department and γ_t are dummy variables for months when the interview and measurement of the child occurred, which account for time trends common to all children interviewed during the same month. X_i' is the vector of covariates at the individual and household level. And ε_{idt} is the error term assumed of mean 0.[23]

It is relevant to control for the characteristics at the department level since the Foundation FUNDAP particularly works in departments with higher prevalence of child undernutrition. For instance, we show in figure 3.3.4 that there is higher prevalence of underweight in Quetzaltenango and San Marcos, and in the data we observe that the largest number of treated children live in these departments (35.5% and 9.5%). Therefore, children living in these locations, were a bit more or less likely to suffer from underweight in 2015 and, thus, be treated by the volunteers in health. However, because children in the control group live in the same departments but have not been treated by the volunteers, this strategy enables us to account for the differences on the average of underweight children among departments.

In addition, the monitoring of children entering the nutritional recovery cycle normally takes place during the second half of the year, when the volunteers have completed certain modules of the training. Thus, we observe in the data[24] that more than half of the anthropometric measurements of treated children have been recovered between September and December and, consequently, higher shares of underweight children among the treated children are found during these months. Therefore, including binary variables for each month in which the children were measured during

[22] Another possible method to estimate the average treatment effect on the treated is the Instrumental Variables. However, we are not able to have a good instrument from the available information provided by the Foundation FUNDAP and hence, we rely on a control strategy to claim the causal interpretation of the estimated coefficient. Further research could focus on analyzing exogenous sources of information in order to implement this type of strategy.

[23] Because we have one observation per child and we lack of reliable household identification, the option to account for robust estimations of the variance has been applied in order to control for heteroscedastic errors.

[24] Tables available upon request.

2015, enables us to adjust for these differences.

Finally, the covariates included in the analysis are those shown in Table 3.3.2. These variables correspond to the information that the Foundation FUNDAP has recovered from the treated children and that we have been able to homogenize with the information available for the control group. We had observed in Table 3.3.2 that these characteristics are not fully balanced across treatment assignment. Particularly, in terms of the characteristics of the household in which the child lives, we had shown that the greatest deprivations in indicators such as access to improved sanitation and the quality of the housing materials, concern children receiving the treatment. Also, the share of girls in the treated sample is significantly higher than in the control group, which might be explained, for instance, by cultural characteristics.

Therefore, controlling for all these observable characteristics enables us to dissipate concerns on the selection bias and help us to rely on the CIA in order to assert that the comparison of average nutritional outcomes across treated and non-treated children has a causal interpretation.[25]

3.5 Main Results

In this section, we present main results from the two analysis that we perfom in this study.

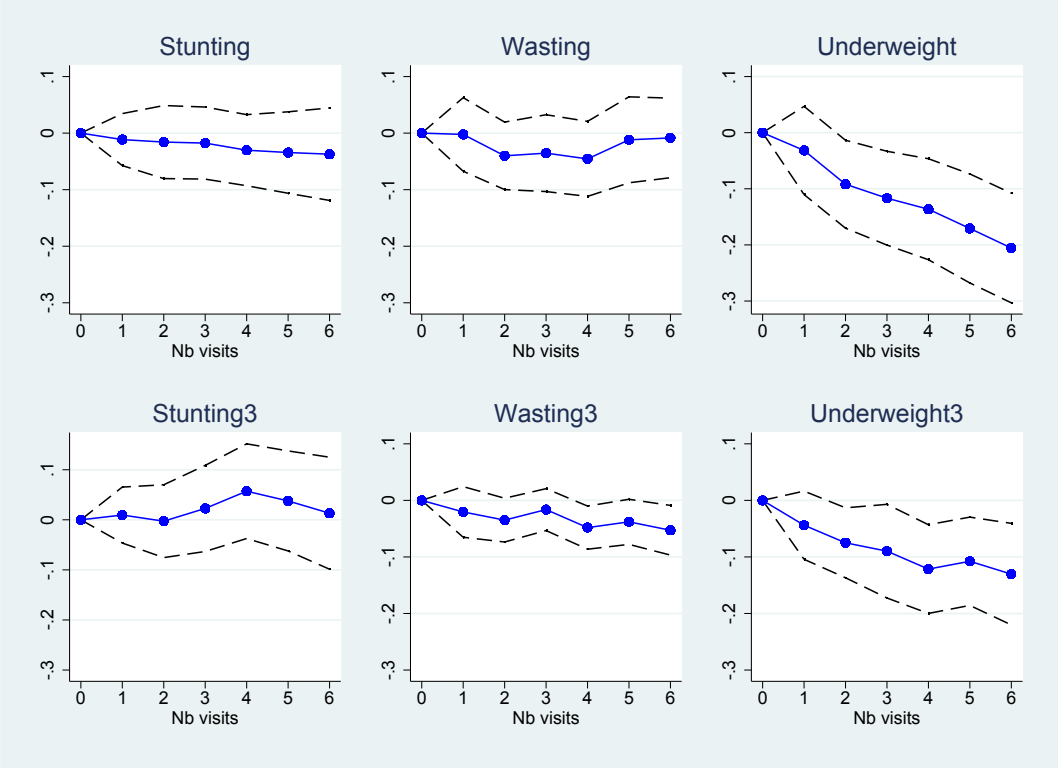
3.5.1 Part 1: Analysis on the Full Sample of Treated Children

We proceed by estimating equation 3.4.1 and plot the estimated coefficients γ_j in figure 3.5.1. These results represent the probability of being stunted, wasted or underweight, also severely, at each visit v relative to the first time the child was seen by a volunteer.

We observe that there seems to be no significant association between an additional visit by the volunteers and the probability of being stunted. Instead, we do find that the probability of being underweight, also severely, significantly starts to drop after the second visit and continues to decrease until the end of the recovery-cycle program. Results for the probability of being severely wasted are stastiscally significant with the fourth and the sixth visit. Table 3.D.1 in the Appendix provides point estimates for each visit. Results suggest that after receiving the sixth and last visit of the volunteers in health, the probability of a treated child of suffering from underweight is 21 p.p. lower with respect to the time in which she/he entered the program, on average. At the same time, the probability to be severely underweight is 13 p.p. lower.

[25]The vector of covariates is built from the available information that the Foundation FUNDAP uses in the implementation of nutritional recovery cycles program. Additionally, the binary variables at the department and at the month of the interview level contribute to capture those characteristics that could have an influence in the selection process and that are difficult to be measured. Thus, we assume that there is an absence of omitted variables bias that enable us to rely on the CIA for a causal interpretation of the estimated ATT coefficient (Angrist and Pischke, 2008).

Figure 3.5.1 – Probability of being stunted, wasted and underweight by number of visits



Notes: each point represents the estimated coefficient γ_j from equation 3.4.1 on the population of children treated by the Foundation from 2015 to 2018. 95% CI included. Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median).

To continue with this analyis, we are now interested in measuring the average probability of being (severely) stunted, (severely) wasted or (severely) underweight when the child has completed a full recovery cycle, compared to that when the cycle is not yet completed. Table 3.5.1 provides results from the estimation of equation 3.4.2.

Findings show that, once we control for the age of the child, time trends, and children time-invariant unobserved characteristics, the average probability of suffering from (severe) underweight is 8.9 (4.6) p.p. lower when a child completes a full recovery cycle. We also observe that treated children who have completed a full recovery cycle, present lower probability of suffering low weight-for-height (3.8 p.p.), compared to when they participate to the program but they have not yet complete it.

Table 3.5.1 – Average effect of having completed one recovery-cycle on the probability of being stunted, wasted or underweight

Variables	(1) Stunting	(2) Wasting	(3) Underweight	(4) Stunting3	(5) Wasting3	(6) Underweight3
Complete Cycle	0.002	-0.020	-0.089**	0.008	-0.038**	-0.046**
	(0.023)	(0.019)	(0.036)	(0.030)	(0.016)	(0.021)
Observations	848	848	848	848	848	848
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Department FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors clustered at the child level in parentheses. Covariates include child's age (in years) and its quadratic specification. Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median). Time dummies are binary variables for the year the child is measured. *** p<0.01, ** p<0.05, * p<0.1

3.5.2 Part 2: Analysis on the Sub-Sample of Children in the Treated and Control Groups

In this section, we present the main results obtained from the estimation of equation 3.4.6. Table 3.5.2 presents main results of the average treatment effect on the treated children of the program "Volunteers in Health" and the nutritional recovery cycle. Each column shows estimation of the regression of each undernutrition outcome on dummy variables at the department level as well as for each month of interview/measurement and the covariates listed in Table 3.3.2. We observe that the underweight (or low weight-for age) coefficient that appears in column 3, is negative and significant at the 10% confidence level. The interpretation that we extract from this result is that, on average, the probability that a child between 10 and 59 months suffered from low weight for her/his age in 2015, significantly decreased by 23.6 p.p. when she/he was monitored by the volunteers in health and thus received the treatment.

According to the Foundation FUNDAP, finding a significant negative result for the weight-for-age indicator and not for the height-for-age or the weight-for-height, might be due to the fact that most of the children that enter in the nutritional recovery cycle already present low height for their age and the intake of micronutritients helps children gain weight rather than height while the recovery lasts. This might also explain the positive statistically significant coefficient that we find for stunting. In this sense, is not that the program increases the probability of treated children to be stunted. Children might gain height during the recovery cycle but this gain might not be enough, so that the children would still present low height for her/his age once the cycle ends. This

Table 3.5.2 – Main results of the program "Volunteers in Health" - ATT effect

Variables	(1) Stunting	(2) Wasting	(3) Underweight	(4) Stunting3	(5) Wasting3	(6) Underweight3
ATT	0.262*	0.024	-0.236*	0.176	-0.000	0.022
	(0.158)	(0.038)	(0.143)	(0.376)	(0.001)	(0.062)
Observations	1,686	1,686	1,686	1,686	1,686	1,686
Department dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors in parentheses. Covariates include ownership of animals in the household, improved sanitation, access to drinking water, good quality of housing materials, child's gender, child's age (in months) and its quadratic specification and whether the child has ever been vaccinated. Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median). Time dummies are binary variables for month interview. *** p<0.01, ** p<0.05, * p<0.1

is consistent to what we find in table 3.3.2: 80.3% of the treated children are stunted, whereas 35% are underweight. Looking closer at the data, 93.8% of those who are underweight are also stunted, which is consistent with the observations from the Foundation FUNDAP.

Following Cashin and Oot (2018), the first 1,000 days from the beginning of the pregnancy of the mother to the second birthday of the child are those when the child is growing more rapidly and requires higher nutritional intake, adequate health care, and a good environment to reach her/his full growth and development potential. During this period, if their nutritional intake is deficient, children are most vulnerable to be stunted and face irreversible consequences such as increased risk of illness and death, delayed mental development, poor school performance and reduced intellectual capacity (WHO, 2010). In other words, the loss of growth and development of a child during these first 1,000 days are difficult to recover after the age of two (Cashin and Oot, 2018). Therefore, since low height-for-age is more difficult to reverse, the results shown in Table 3.5.2 seem to translate a more likely gain of weight, rather than height, during the period the child is in the nutritional recovery cycle. One could think that children under the age of two improving their weight-for-age over time (and not just during the treatment period), might also be able to improve their height. For this to be analyzed, the Foundation FUNDAP would need to recover data from under two years old treated children after some period of time.

In Table 3.5.3, it is relevant to note that a naive comparison of outcomes as it is done in column 1, just informs us that children monitored by the volunteers in 2015 were significantly less healthy, on average. More precisely, the share of treated children presenting low weight for their age was 19 p.p higher than the share of non-treated children, which is what we observe in the descriptives of

Table 3.5.3 – Baseline results of the program "Volunteers in Health" - ATT effect

Variables	(1) Underweight	(2) Underweight	(3) Underweight
ATT	0.190***	-0.091	-0.145
	(0.042)	(0.087)	(0.135)
Observations	1,686	1,686	1,686
Time dummies	No	Yes	Yes
Department dummies	No	No	Yes
Covariates	No	No	No

Notes: robust standard errors in parentheses. Covariates include ownership of animals in the household, improved sanitation, access to drinking water, good quality of housing materials, child's gender, child's age (in months) and its quadratic specification and whether the child has ever been vaccinated. Underweight makes reference to low weight-for-age (z-score is -2 standard deviation from the WHO median). Time dummies are binary variables for month interview. *** p<0.01, ** p<0.05, * p<0.1

Table 3.3.2. Proceeding with this naive comparison would make us conclude that the program of the Foundation FUNDAP made children sicker. However, when we start controlling for the month the child was interviewed (column 2 of table 3.5.3) and also for time-invariant characteristics at the department level (column 3 of table 3.5.3), we observe that the coefficient of the treatment variable becomes negative, although still not significant.

In Table 3.5.4 we go step by step adding family and individual characteristics that play a role in the selection of the treated sample and that might hint the average effect of the program on the nutritional health of children. We have seen in the previous section that it is relevant to control for these observable characteristics in order to be able to compare average nutritional outcomes across treated and non-treated children and give the average treatment effect of the program on the treated children (ATT) a causal interpretation. Therefore, we proceed to include them and show that β, the coefficient of the ATT, becomes statistically significant at the 10% confidence level when we start controlling for these observable characteristics, underlining their relevance in the estimated equation. Moreover, the coefficient is quite stable across specifications.

We further observe that the coefficients of some variables, such as improved sanitation, good housing materials and access to drinking water, are statistically significant and negatively related with the probability of being underweight. Additionally, we know from Table 3.3.2, that treated children are more significantly deprived in the first two, whereas children in the control group have less significant access to drinking water. By including these variables in the regression, we are able to control for those characteristics that might help explain the selection of the child into the treatment and, thus, interpret the ATT coefficient as the effectiveness of the program "Volunteers in Health" in the reduction of the underweight prevalence among children between 10 and 59 months

Table 3.5.4 – Baseline results of the program "Volunteers in Health" - ATT effect

Variables	(1) UW	(2) UW	(3) UW	(4) UW	(5) UW	(6) UW	(7) UW
ATT	-0.237*	-0.253*	-0.251*	-0.235*	-0.235*	-0.248*	-0.236*
	(0.137)	(0.139)	(0.139)	(0.140)	(0.141)	(0.140)	(0.143)
Good housing materials	-0.101***	-0.092***	-0.091***	-0.094***	-0.094***	-0.094***	-0.094***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Improved sanitation		-0.069**	-0.069**	-0.066**	-0.066**	-0.067**	-0.066**
		(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Ownership animals			0.007	0.012	0.012	0.013	0.013
			(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Drinking water				-0.041*	-0.042**	-0.042*	-0.041*
				(0.021)	(0.021)	(0.021)	(0.021)
Ever vaccinated					0.009	0.009	0.007
					(0.030)	(0.030)	(0.030)
Gender: girl						-0.028	-0.028
						(0.018)	(0.018)
Age in months							0.006*
							(0.003)
Age in months (squared)							-0.000**
							(0.000)
Observations	1,686	1,686	1,686	1,686	1,686	1,686	1,686
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Department dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors in parentheses. UW makes reference to underweight – low weight-for-age (z-score is -2 standard deviation from the WHO median). Time dummies are binary variables for month interview. *** p<0.01, ** p<0.05, * p<0.1

of age in West Guatemala in 2015.

3.6 Robustness Checks

In this section, we intend to further check that baseline results are indeed stable, in order to be able to draw conclusions from them.

3.6.1 Part 1: Analysis on the Full Sample of Treated Children

To test for the robustness of results found in table 3.5.1, we re-estimate equation 3.4.2 on the extended sample of children who completed more than one recovery cycle. Results are shown in table 3.6.1 and confirm previous findings: participating into one or two nutritional recovery cycles is associated with lower probability of suffering underweight (10.1 p.p), severe underweight (5.4 p.p.) and wasting (3.0 p.p.), on average.

Table 3.6.1 – Average effect of having completed one recovery-cycle on the probability of being stunted, wasted or underweight

Variables	(1) Stunting	(2) Wasting	(3) Underweight	(4) Stunting3	(5) Wasting3	(6) Underweight3
Complete Cycle	0.017	-0.006	-0.101***	0.011	-0.030**	-0.054**
	(0.025)	(0.022)	(0.034)	(0.026)	(0.015)	(0.027)
Observations	975	975	975	975	975	975
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Department FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Covariates	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors clustered at the child level in parentheses. Covariates include child's age (in years) and its quadratic specification. Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median). Time dummies are binary variables for the year the child is measured. *** p<0.01, ** p<0.05, * p<0.1

3.6.2 Part 2: Analysis on the Sub-Sample of Children in the Treated and Control Groups

To test for the stability of results found in table 3.5.2 and table 3.5.4, we proceed by perfoming two robustness checks: the first consists on a falsification test and the second one controls for the lean (or dry) season in Guatemala.[26]

In order to proceed with the first one, we rely only on data from the National Maternal and Children's Health Survey, but for the year 1998/1999. As in the main analysis, we defined treated children as those living in the municipalities in which the volunteers in health worked during 2015 and control children as those living in the same departments but in municipalities where the volunteers in health did not work in 2015.[27] The main purpose of this robustness check is to assess whether, before the implementation of the program and conditional on observable characteristics, there were significant differences in underweight outcomes between children living in municipalities that will become treated and those that will not. Finding negative statistically significant coeffi-

[26] We also perfom a propensity score matching, using the covariates listed in table 3.3.2, the department identification and the month when children are interviewed/measured. However, the matching did not succeed in creating a sufficient sample to calculate the average treatment effect due to low matches in the month of the interview. We acknowledge this limitation and we claim that, so far, this is the best that we are able to do. Further research would focus on retrieving data on a better control group in order to be able to improve the matching and the estimation of the effectiveness of the program.

[27] The National Maternal and Children's Health Survey of 1998/1999 does not have GPS data and municipalities are only coded with a number, without any label. This does not enable us to properly identify the municipalities and for this matter we use available information in https://www.gifex.com/. This website provides large mapping information, among which number and name identification of the municipalities of each department. We acknowledge this might not be the most accurate procedure, but so far it is the best we have found.

cients would mean that the decrease in the probability of children suffering from underweight in the treated municipalities is not due to the program "Volunteers in Health", but rather to something else.

Table 3.6.2 – Robsutness checks: 1998/1999 analysis

Variables	(1) Underweight	(2) Underweight	(3) Underweight
ATT	0.041	0.066	0.092
	(0.059)	(0.070)	(0.071)
Observations	294	294	194
Time dummies	No	Yes	Yes
Department dummies	No	Yes	Yes
Covariates	No	No	Yes

Notes: robust standard errors in parentheses. Covariates include improved sanitation, access to drinking water, good quality of housing materials, child's gender, child's age (in months) and its quadratic specification and whether the child has ever been vaccinated. Underweight makes reference to low weight-for-age (z-score is -2 standard deviation from the WHO median). Time dummies are binary variables for month interview. *** p<0.01, ** p<0.05, * p<0.1

Results are presented in Table 3.6.2. Column 3 reproduce baseline estimations of equation 3.4.6. We observe that coefficients are not statistically significant in any of the specifications. Therefore, we are able to assert that our baseline results presented in column 3 of Table 3.5.2 (and in column 7 of Table 3.5.4) are specific to the program "Volunteers in Health" and the implementation of the nutritional recovery cycles by the Foundation FUNDAP.

The last robustness check that we try is to control for the lean season. This corresponds to those months of the year characterized by a drier weather that particularly affects tropical countries. During these months, the harvest from the first sowing season is almost concluded and the dry weather not only delays and reduce plantings but also affects crop development and yields negatively (FAO, 2015). In Guatemala, the most affected are the dry corridor and the south coast, which corresponds to the Central-North and West departments of the country. Because employment is also low during this season, subsistence households are more vulnerable to face food insecurity and are in need of assistance (FAO, 2015).

Following the FAO (2015) report, the lean season in Guatemala takes place between April and July, included. Therefore, we proceed to create binary variables for this months of the year and we introduce them in equation 3.4.6 and re-estimate previous regressions on underweight. Column 3 of Table 3.6.3 shows that the baseline results found in the previous section are robust when controlling for the months of the year when children are potentially more vulnerable to be underweight due to the restrictive weather conditions.

Table 3.6.3 – Robustness checks: lean season

Variables	(1) Underweight	(2) Underweight	(3) Underweight
ATT	0.215***	-0.145	-0.236*
	(0.045)	(0.135)	(0.143)
Observations	1,686	1,686	1,686
Time dummies	No	Yes	Yes
Department dummies	No	Yes	Yes
Covariates	No	No	Yes

Notes: robust standard errors in parentheses. Covariates include ownership of animals in the household, improved sanitation, access to drinking water, good quality of housing materials, child's gender, child's age (in months) and its quadratic specification and whether the child has ever been vaccinated. Underweight makes reference to low weight-for-age (z-score is -2 standard deviation from the WHO median). Time dummies are binary variables for month interview. *** p<0.01, ** p<0.05, * p<0.1

All in all, despite not having accurate data on children who did not enter the nutritional recovery cycle but who, nonetheless, were measured by the volunteers, the analysis of the present study is able to show that the program of "Volunteers in Health" and the service on nutritional recovery cycles had a significant impact on the improvement of children's nutritional status in 2015 in Western Guatemala.

3.7 Conclusions

Child malnutrition is still a major challenge, both in developed and developing countries. Effective policies are hard to define, given the heterogeneity of malnutrition forms and social conditions of targeted children. In this paper, we provide evidence of the effectiveness of a program aimed at alleviating child undernutrition in a particularly poor socio-economic context in Western Guatemala. The program, called "Volunteers in Health", operates at the local level and aims at providing specific knowledge within communities in order to raise awareness on child health and nutritional habits. Community inhabitants, mostly women, who participate in the program are trained to become the first source of knowledge and help for mothers in a region where ignorance on fertility and newborn childcare is still high. They implement a specific service, the nutritional recovery cycle, by visiting children once per month for 6 months and providing mother with food supplements.

We find that, as the nutritional recovery cycle goes on, children nutritional status improves. Starting from the second visits, the probability for children of being underweight starts to decrease as compared to the timing in which they entered the program. After having completed one recovery cycle, the probability for children to be underweight is 21 p.p. lower. On average, controlling for age, time trends and children time-invariant unobserved heterogeneity, completing a nutritional

recovery cycle is associated with 8.9 p.p. lower probability to be underweight.

We provide further evidence on the nutritional recovery cycle program by comparing standard health outcomes between children who lived in municipalities where the volunteers worked and those of children living in close municipalities where the volunteers did not reach yet in 2015. Controlling for a large set of observable characteristics, which help mitigate concerns of selection bias, we are able to find that the program was significantly effective in improving nutritional health of treated children. More precisely, we find that, on average, the probability that a child between 10 and 59 months suffered from low weight for her/his age in 2015 decreased significantly by 23.6 p.p. when she/he was monitored by the health volunteers and her/his mother received the adequate knowledge regarding the health of her child.

These results are robust to different tests. In particular, expanding the sample including the most sick treated children did not affect the main findings on the average effect of the nutritional recovery cycle program. Results from the falsification tests that we carry out using data prior to the beginning of the implementation of the program in Western Guatemala (National Maternal and Children's Health Survey of 1998/99) provide further evidence of the stability and robustness of our findings, as when controlling for the dry season in Guatemala.

Our results point out that the definition of ad-hoc policies which operate at the local level and involve the participation of all members of the communities can be particularly effective in reducing child undernutrition. Our work underlines how educating women, a strong empowerment factor, represents a powerful instrument which has beneficial effects at the individual, household and community level.

Further research would focus on improving the data for a comparable group of children in order to be able to improve matching analysis and be able to draw a more robust result on the effectiveness of the program "Volunteers in Health" and the service the volunteers provide, the nutritional recovery cycles.

Appendix

3.A Description of Variables

3.A.1 Variables on Undernutrition

Malnutrition may appear in the form of undernutrition or overweight (De-Onis and Blossner, 1997). This study focuses on undernutrition and its major types that are:

- Acute malnutrition (wasting/low weight-for-height): wasting indicates, in most cases, a recent and serious risk of weight loss, that is most frequently associated with acute hunger and/or serious disease. Nonetheless, wasting can also be the result of chronic unfavorable conditions.
- Chronic malnutrition (stunting/low height-for-age): low height-for-age reflects a process of inability to reach a linear growth potential as a result of suboptimal health and/or nutritional conditions. At the population base, high levels of stunting are associated with bad socioeconomic conditions and a higher risk of frequent and sooner exposure to adverse conditions, like diseases and/or inadequate feed practices.
- Underweight (combine stunting and wasting/ low weight-for-age): low weight-for-age reflects low body mass in relation to the chronologic age of the child, and it is influenced by both the height of the child (height-for-age) and his/her weight (weight-for-height). This indicator fails to distinguish between short children of adequate body weight and tall, thin children. Nonetheless, in the absence of significant wasting within a community, similar information is provided by weight-for-age and height-for-age, in that both reflect the long-term health and nutritional experience of the individual or population.

The way to identify whether a child from birth to five years of age faces any of the three types of malnutrition is through her/his anthropometric measurement (weight-for-age, height-for-age and weight-for-height). According to these measures, a z-score is calculated, which is used to compare the results from the child to those from the accepted international reference population's median value calculated by the World Health Organisation (WHO) and which is sex-specific. If the z-score is below minus two standard deviations from the median of the reference population, the child can

be either classified with low weight-for-height (wasted), low height-for-age (stunted) and low weight-for-age (underweight). If the z-score is below minus three standard deviations from the median of the reference population, the child is classified as severely wasted, stunted or underweight.

3.A.2 Variables on Household's Characteristics

These variables have been coded following the Millenium Development Goals Guidelines (United Nations, 2009b) as follows:

- Improved sanitation: the household has access to improved sanitation facilities that flush to a piped sewer system or to a septic tank or has latrine or ventilated improved pit latrine.
- Access to drinking water: the household has access to water piped into dwelling, piped to yard/plot, has public tap/standpipe or other piped.
- Ownership of animals: the household owns livestock herds or farm animals.
- Good quality of housing materials: the household has walls of good quality, such as cement, stone with lime/cement, bricks, cement lock or covered adobe

3.B Treated Departments

Table 3.B.1 summarizes the main characteristics of the departments where the Foundation FUNDAP is implementing the program "Volunteers in Health". Statistics are derived from the 2014/2015 National Maternal and Children's Health Survey used in the empirical analysis.

Against a country average of 41.5%, most of treated departments have a larger share of indigenous population, that reaches more than 90% in Quiché, Sololá, and Totonicapán. The share of individuals living in rural areas is high, especially in the departments of Huehuetenango, Quiché and San Marcos.

Only three departments (Retalhuleu, San Marcos and Suchitepéquez) show a share of individuals with no education below the country's average of 28.0%. In the departments of Huehuetenango and Quiché almost half of the individuals sampled have zero level of education.

As regards health coverage, the most penalized departments are those of Huehuetenango, Quiché, San Marcos, and Totonicapán, where less than 50% of respondents declare to have an easy access to health care facilities.

Table 3.B.1 – Treated departments: main characteristics

	% Indigenous	% Rural	% Not Educated	% Health coverage	Observations
Huehuetenango	66.9	79.9	47.4	39.3	2,815
Quetzaltenango	52.5	51.5	28.6	57.4	2,428
Quiché	93.6	81.2	49.7	46.4	3,174
Retalhuleu	19.5	67.4	19.2	52.1	2,190
San Marcos	34.9	81.8	24.2	44.1	2,713
Sololá	95.4	55.1	38.0	61.0	2.503
Suchitepéquez	35.6	59.3	23.3	56.9	2,347
Totonicapán	95.0	68.1	36.1	42.7	2,657
Country	41.5	63.4	28.0	55.5	55,398

Notes: statistics produced from the raw data available in the last National Maternal and Children's Health Survey of 2014/2015. Health coverage is measured as accessibility to health care facilities.

3.C Review of Some Health Programs' Evaluation in Latin America

Table 3.C.1 summarizes some key aspects of the impact evaluation of education and health programs on children growth indicators in Latin America.

Table 3.C.1 – Review of some health programs' evaluation in Latin America

Country	Reference	Program	Analysis	Main results	Channels
Brazil	Paes-Sousa and Santos (2009)	Bolsa de Familia Program (BFP): cash transfers conditional on households engaging in improving behavior on health and education since 2004	Impact evaluation of the BFP on children antropometric indicators using data collected during vaccination campaigns btw2005 and 2006 in 4 regions	Probability of suffering from stunting or underweight decreases by 26% when child btw 0 and 5 years old receives the BFP	Change in dietary patterns, budget improvement to purchase more food, aspirations to eat more healthy. Not specification of the impact of each aspect
Mexico	Gertler (2004)	Pogresa: conditional cash transfers program to engage households in improving behavior on health, nutrition and education, since 1997	Impact evaluation of Progresa on children morbidity, height and anemia using data from large socioeconomic survey on experimental villages	Treated children are 25.5% less likely to be ill and to be anemic and they are 0.96 cm taller	Growth monitoring, pre/postnatal care, parental education on nutrition, health and hygiene, and nutritional supplements. Does not indicate which aspects matter
Colombia	Rojas et al. (2007)	Familias en Acción: cash transfers to poorest families to improve nutritional health and education of children, conditional on growth monitoring and school attendance, since 1990	difference-in-difference using semi-experimental data for two cities treated eligible non-treated, to evaluate impact on health and education indicators	Treated children are 0.45cm taller than control children and the probability of suffering acute diarrheal disease decreases by 10 p.p.	Growth monitoring in health facilities Not clearly specified

3.D Additional Results

Table 3.D.1 – Probability of being stunted, wasted and underweight by number of visits

	(1) Stunting	(2) Wasting	(3) Underweight	(4) Stunting3	(5) Wasting3	(6) Underweight3
1 visit	-0.0114	-0.00233	-0.0317	0.00953	-0.0204	-0.0439
	(-0.49)	(-0.07)	(-0.80)	(0.34)	(-0.90)	(-1.44)
2 visits	-0.0158	-0.0401	-0.0918**	-0.00269	-0.0349	-0.0750**
	(-0.48)	(-1.33)	(-2.32)	(-0.07)	(-1.78)	(-2.40)
3 visits	-0.0176	-0.0354	-0.117***	0.0227	-0.0163	-0.0898**
	(-0.55)	(-1.03)	(-2.76)	(0.52)	(-0.87)	(-2.15)
4 visits	-0.0302	-0.0456	-0.136***	0.0572	-0.0481**	-0.121***
	(-0.95)	(-1.36)	(-3.00)	(1.20)	(-2.50)	(-3.07)
5 visits	-0.0343	-0.0118	-0.171***	0.0377	-0.0379	-0.108***
	(-0.94)	(-0.31)	(-3.48)	(0.75)	(-1.88)	(-2.73)
6 visits	-0.0372	-0.00848	-0.206***	0.0132	-0.0528**	-0.130***
	(-0.90)	(-0.24)	(-4.17)	(0.23)	(-2.38)	(-2.88)
Observations	844	844	844	844	844	844
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors clustered at the child level in parentheses. Covariates include child's age (in years) and its quadratic specification. Stunting, wasting and underweight make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -2 standard deviation from the WHO median). Stunting3, wasting3 and underweight3 make reference to low height-for-age, low height-for-weight and low weight-for-age (z-score is -3 standard deviation from the WHO median). Time dummies are binary variables for the year the child is measured. *** p<0.01, ** p<0.05, * p<0.1

General Conclusions and Further Research

The research developed in this Thesis seeks to provide greater understanding on the determinants of poverty and well-being in developing countries and, by doing so, to highlight several paths to achieve the two first Sustainable Development Goals of the Agenda 2030. Starting from a macroeconomic angle using national data, to deepen the analysis towards a microeconomic perspective using individual and household level data, this Thesis explores the types of social deprivations that characterize poverty and the factors that have a significant impact on some of them such as the nutritional health of children. It begins with a macroeconomic analysis for 64 developing economies, to continue with an analysis based on survey data for Guatemala, and finalizes with an impact evaluation using more specific individual data from a health program implemented by the Foundation FUNDAP in the western regions of the same country.

More precisely, Chapter 1 analyzes the relationship between development aid and poverty reduction, a topic for which previous studies have not yet produced conclusive results. Two main challenges still require some attention. The first is to properly identify the causal effect of aid on poverty alleviation. To address it, I exploit differences in the number of years countries have been temporary members of the United Nations Security Council as an instrument for the average amount of economic aid disbursed by the United States. The second is to obtain reliable data on poverty, which I confront by using multidimensional poverty data from the Oxford Poverty and Human Development Initiative (OPHI). For a sample of 64 developing countries, I estimate a significant relationship between higher amounts of aid received during the period 1946–1999 and lower Multidimensional Poverty Index (MPI) between 2000 and 2014. On the contrary, the relationship does not seem to be significant when poverty is measured from an income perspective. Alternative measures of poverty could help improve the understanding of the relationship between development aid and poverty alleviation and might also contribute to improved targeting for aid disbursements.

Further research should focus on analysing the effect of more precise dimensions of aid on the

intended social deprivations. For instance, one could analyze whether aid disbursed for health purposes, contributes to reduce the percentage of the population who is multidimensionally poor and deprived in nutrition or child mortality. Using more detailed information at the household or individual level through simulation methods, could also contribute to the understanding of the relationship between public budget allocation and poverty alleviation. Further research would also search to build a panel dataset that includes the temporal dimension, which could be useful to account for time trends common to a group of countries, for instance. Enlarging the available data on poverty would be, in this sense, very helpful, since one would be able to obseve how poverty levels are evolving over time. Finally, a particular focus should be made on finding an alternative instrumental variable, which would contribute to further test for the stability of the main results and provide greater understanding on the effectiveness of aid in reducing poverty worldwide.

Chapter 2 aims to understand and evaluate to what extent the expansion of african palm crop in Guatemala (agro-export sector) contributes to increasing food insecurity, as measured by higher child undernutrition. The struggle for water and land use in Guatemala has intensified in the last decade due to the accelerated expansion of the agro-export sector. Particularly, in the south-west region, the recent expansion of african palm crop has taken place at the expense of illegal dredging of rivers, the improper use of water resources and the purchase and forced dispossession of communal and family lands of the indigenous population. This situation not only represents a destructuring of the established order within families and within indigenous communities, but also compromises the nutritional health of the most vulnerable members, such as children and women. This study provides evidence on how the rapid development of this agro-export crop has contributed to increase the probability of children suffering from chronic malnutrition in the region, and particularly those from indigenous mothers, living in urban areas and in households where the head of the family is a man.

Despite this study is focused on the social impact, it is noteworthy to underline that the negative impact has also been environmental and, thus, economic. Since other parts of Guatemala are currently being damaged by the aggressive expansion of african palm crop – such as those in the northen region of Petén and the lowlands of northern Guatemala –, it is difficult to quantify the potential long-term impact that these practices will have on the economic and sustainable development of the country. Forthcoming released data from the next wave of the National Maternal and Children's Health survey, could contribute to a better understanding of the current social and environmental implications of the expansion of african palm crop, also in North Guatemala. If possible, further research would focus on collecting individual information on the topic through field work in the country. Also, analyzing the situation of neighbouring countries, such as Nicaragua, could help to provide further insight on the risks that this growth model is entailing for the food and nutrition security of the local population.

The last study presented in Chapter 3, seeks to evaluate the effect of a nutritional intervention in West Guatemala, called "Volunteers in Health", which operates at the community level and builds capacity by training individuals (90% women) on issues related to child nutrition and basic nursing. The highest rates of child undernutrition in Guatemala are found in Western regions, where more than half of the children under five are stunted and almost 20% underweight. However, despite the large incidence of undernutrition in the country, there is no robust evidence of its determinants, effects and possible solutions. This study analyses the impact of the program "Volunteers in Health", implemented since 2001 by the Foundation FUNDAP in West Guatemala, on the nutritional health of children under five years of age. It provides new evidence on how educating women at the community level to provide information on infants' nutrition to mothers, together with the monitoring of children's growth and the supply of food supplements, contributes to significantly reduce the probability of children being underweight in West Guatemala.

Further research would focus on improving the data for a comparable group of children in order to be able to improve matching analysis and be able to draw a more robust result on the effectiveness of the program "Volunteers in Health" and the service the volunteers provide, the nutritional recovery cycles. In this sense, being able to travel to Guatemala, would be very a great opportunity to get to meet with the volunteers, as well as to carry out some field work in order to better understand the implications of the valuable work they do to improve the health and the quality of life of mothers and children in West Guatemala.

All in all, from a macroeconomic to a microeconomic perspective, the analyses developed in this Thesis enable to better understand the different factors that play a role (positively and negatively) on the well-being of individuals worldwide, and particularly of Guatemalan children. For instance, we learn that the practices through which african palm is expanding in Guatemala need to be improved, so that they ensure protection towards the most vulnerable population and promote sustainable agriculture in order to achieve food security and zero hunger in the country. Within this context, international aid might play a relevant role in financing public policies which operate at the local level and involve the participation of all members of the communities, such as nutritional interventions directed towards women and children. We observe indeed, that these types of programs can not only be particularly effective in reducing child undernutrition, but also contribute to empower women by increasing their level of education as well as their knowledge about their children's health.

To conclude, I wish to express that this Thesis is aimed to raise awareness among the academic and international community and to be used by students to learn about the social and environmental context of the beautiful Guatemala, as to inspire them for further research in this area.

Conclusions Générales et Recherches Futures

Les recherches développées dans cette Thèse visent à mieux comprendre les déterminants de la pauvreté et du bien-être dans les pays en développement et, ce faisant, à mettre en évidence plusieurs pistes d'actions possibles permettant d'atteindre les deux premiers objectifs de développement durable à l'horizon 2030. En partant d'un angle macroéconomique à l'aide de données nationales, et en poursuivant l'analyse à un niveau microéconomiqueen utilisant des données individuelles et au niveau des ménages, cette Thèse explore les types de privations sociales qui caractérisent la pauvreté ainsi que certains facteurs qui ont un impact significatif sur certaines de ces privations, telles que la santé nutritionnelle des enfants. La Thèse commence par une étude macroéconomique couvrant 64 économies en développement, se poursuit par une analyse basée sur des données d'enquête pour le Guatemala, et se termine par une évaluation d'impact en utilisant des données individuelles plus spécifiques relatives à un programme de santé mis en œuvre par la Fondation FUNDAP dans les régions occidentales du même pays.

Le Chapitre 1 analyse la relation entre la hausse de l'aide au développement et la réduction de la pauvreté, sujet sur lequel la littérature n'a pas encore produit des résultats tranchés. L'analyse nécessite en effet de répondre à deux défis principaux. Le premier consiste à identifier correctement l'effet causal de l'aide sur la réduction de la pauvreté. Pour y remédier, j'exploite les différences dans le nombre d'années durant lesquelles les pays ont été membres temporaires du Conseil de sécurité des Nations Unies en tant qu'instrument du montant de l'aide économique reçue des États-Unis. Le second défi consiste à utiliser des données fiables sur la pauvreté, à partir des données de pauvreté multidimensionnelle émanant du centre de recherche Oxford Poverty and Human Development Initiative (OPHI). En utilisant un échantillon de 64 pays en développement, mes résultats montrent une relation significative entre des montants d'aide plus élevés reçus pendant la période 1946-1999 et une réduction de l'Indice de Pauvreté Multidimensionnelle (IPM) entre 2000 et 2014. Cette relation n'est toutefois pas significative lorsque la pauvreté est mesurée sous l'angle du revenu. Ce Chapitre montre ainsi que des mesures alternatives de la pauvreté peuvent aider à mieux appréhender la

relation entre l'aide au développement et la réduction de la pauvreté et également contribuer à améliorer le ciblage de l'aide au développement.

Les perspectives de recherche que j'envisage consisteront à prendre en compte des dimensions plus précises de l'aide au développement ainsi que des privations sociales. Par exemple, il serait pertinent d'analyser si l'aide allouée à des fins de santé contribue à réduire le pourcentage de la population touchée par la pauvreté multidimensionnelle et souffrant de sous-alimentation ou de mortalité infantile. L'utilisation d'informations plus détaillées au niveau des ménages ou des individus pourrait également contribuer à la compréhension de la relation entre l'allocation de l'aide et la réduction de la pauvreté. La prise en compte de la dimension temporelle pourrait être utile également pour tenir compte des tendances temporelles communes à un groupe de pays. Une meilleure couverture temporelle des données relatives à la pauvreté multidimensionnelle serait, en ce sens, très utile, car elle permettrait d'analyser comment les niveaux de pauvreté évoluent dans le temps. Enfin, il s'agira également d'inclure une variable instrumentale alternative, qui permettrait de tester la stabilité de mes principaux résultats et de mieux comprendre les mécanismes avec lesquels l'aide au développement peut contribuer à la réduction de la pauvreté dans le monde.

Le Chapitre 2 vise à comprendre et à évaluer dans quelle mesure l'expansion de la culture d'huile de palme au Guatemala (secteur agroalimentaire exportateur) contribue à accroître l'insécurité alimentaire, mesurée ici par la malnutrition infantile. La lutte pour l'utilisation de l'eau et des terres au Guatemala s'est intensifiée au cours des dernières décennies en raison de l'expansion accélérée de ce secteur agroalimentaire exportateur. En particulier, dans la région du sud-ouest, l'expansion récente de la culture d'huile de palme s'est faite en favorisant un dragage illégal des fleuves, une utilisation abusive des ressources en eau, l'achat et la dépossession forcée de terres familiales appartenant à la population indigène. Cette situation représente non seulement une déstructurationde l'ordre établi au sein des familles et des communautés autochtones, mais aussi compromet la santé nutritionnelle des membres les plus vulnérables, tels que les enfants et les femmes. Cette étude montre comment le développement rapide de cette culture dans la région du sud-ouest du Guatemala a contribué à augmenter la probabilité que les enfants souffrent de malnutrition chronique. Cet effet concernant en particulier les enfants de mères autochtones, vivant dans des zones urbaines et des ménages où le chef de famille est un homme.

Bien que notre travail se concentre sur l'impact social de la culture d'huile de palme, il convient de souligner que ce type de culture a également des effets négatifs environnementaux et donc économiques. Dans la mesure où d'autres régions du Guatemala sont actuellement touchées par l'expansion de la culture d'huile de palme - comme celles de la région nord de Petèn et des basses terres du nord du Guatemala -, il est difficile de quantifier, pour l'instant, l'impact potentiel à long terme que ces pratiques auront sur le développement économique et durable du pays. L'exploitation

des prochaines données publiées de la prochaine vague de l'enquête nationale sur la santé des mères et des enfants, pourrait contribuer à une meilleure compréhension de la situation sociale et les implications environnementales de l'expansion de cette culture, non seulement dans les départements de notre échantillon mais également dans les régions du nord du Guatemala. Dans mes recherches futures, je compte collecter et traiter ces informations supplémentaires. En outre, l'analyse de la situation des pays voisins, comme le Nicaragua, pourrait également mieux éclairer les risques que ce modèle de croissance fait peser sur la sécurité alimentaire de la population locale.

La dernière étude présentée dans le Chapitre 3, cherche à évaluer l'effet d'un programme nutritionnel dans l'ouest du Guatemala, appelé "Volontaires en santé", qui opère au niveau communautaire. Ce programme vise à construire des capacités en formant des individus (90% de femmes) aux questions liées à la nutrition des enfants et aux soins infirmiers de base. Les taux les plus élevés de malnutrition infantile au Guatemala se trouvent dans les régions occidentales, où plus de la moitié des enfants de moins de cinq ans ont un retard de croissance et près de 20% se caractérisent par une insuffisance pondérale. Malgré les effets négatifs élevés exercés par la sous-alimentation dans le pays, il n'existe aucune preuve solide de ses déterminants, de ses effets et des solutions possibles pour la faire diminuer. Cette étude analyse l'impact du programme "Volontaires en santé", mis en œuvre depuis 2001 par la Fondation FUNDAP dans l'ouest du Guatemala, sur la santé nutritionnelle des enfants de moins de cinq ans. Nos résultats montrent comment l'éducation des femmes au niveau communautaire sur l'alimentation des nourrissons, ainsi que le suivi de la croissance des enfants et la fourniture de compléments alimentaires, contribuent à réduire considérablement la probabilité que les enfants souffrent d'insuffisance pondérale dans l'ouest du Guatemala.

Une meilleure qualité des données concernant un groupe comparable d'enfants permettrait d'améliorer notre analyse et obtenir un résultat plus robuste sur l'efficacité du programme "Volontaires en Santé" et des services que les volontaires fournissent, les cycles de récupération nutritionnelle. A cet égard, un séjour au Guatemala me fournirait une excellente opportunité de rencontrer les volontaires et effectuer des travaux sur le terrain afin de mieux comprendre les implications de leur précieux travail pour améliorer la santé et la qualité de vie des mères et des enfants dans l'ouest du Guatemala.

Au total, d'un point de vue macroéconomique à un microéconomique, les analyses développées dans cette Thèse permettent de mieux comprendre les différents facteurs qui jouent un rôle (positif et négatif) sur le bien-être des individus dans le monde, et en particulier des enfants guatémaltèques. Par exemple, nous apprenons que les pratiques par lesquelles la culture d'huile de palme se développe au Guatemala doivent être améliorées, afin qu'elles assurent une protection envers la population la plus vulnérable et promeuvent une agriculture durable afin d'atteindre la sécurité alimentaire et la faim zéro dans le pays. Dans ce contexte, l'aide internationale pourrait jouer un rôle pertinent

dans le financement des politiques publiques qui opèrent au niveau local et impliquent la participation de tous les membres des communautés, telles que les interventions nutritionnelles destinées aux femmes et aux enfants. Nous observons, en effet, que ces types de programmes peuvent non seulement être particulièrement efficaces pour réduire la dénutrition infantile, mais aussi contribuer à autonomiser les femmes en augmentant leur niveau d'éducation ainsi que leurs connaissances sur la santé de leurs enfants.

Pour conclure, je souhaite exprimer que cette Thèse vise à sensibiliser la communauté universitaire et internationale, ainsi qu'à être utilisée par les étudiants pour en apprendre davantage sur le contexte social et environnemental du magnifique Guatemala, afin de les inspirer pour de nouvelles recherches dans ce domaine.

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