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Investissements directs étrangers et sécurité alimentaire dans les pays en développement

Mehdi Ben Slimane

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RÉSUMÉ ABSTRACT

Investissements directs étrangers et sécurité alimentaire dans les pays en développement

Les pays en développement (PED) enregistrent un taux de croissance démographique particulièrement élevé et une forte demande alimentaire. Par ailleurs, l'investissement direct étranger (IDE) est au centre des politiques d'investissement de ces pays. Les PED attirent l'IDE pour améliorer la croissance économique. Cette vision optimiste est contredite par des effets négatifs sur leur économies. En se basant sur trois facteurs que nous jugeons très importants pour la sécurité alimentaire (SA) : la production agricole, la qualité institutionnelle et la dépendance en importation alimentaires, nous investiguons les effets de l'IDE sur la SA. Les résultats montrent que l'IDE agricole améliore la SA et l'IDE secondaire améliore la production agricole grâce au transfert technologique et savoir-faire avec des effets nuisibles qui peuvent apparaître comme la pollution de l'environnement. L'IDE tertiaire a tendance à baisser la main d'œuvre dans l'agriculture et à augmenter la demande alimentaire dans les zones urbaines. En ajoutant l'institution locale à l'analyse, les résultats montrent qu'à partir de certains seuils de qualité institutionnelle, l'IDE primaire et secondaire améliorent la SA. L'intérêt des PED est d'améliorer leur qualité institutionnelle et de cibler l'attraction de l'IDE. Finalement, l'IDE total a tendance à détériorer la capacité à importer des produits alimentaires dans les pays à revenu faible et moyen inférieur. Ces pays ont intérêt à attirer des IDE orientés à l'exportation.

Mots-clés : sécurité alimentaire ; IDE ; production agricole ; institution ; commerce ; prix de l'énergie

Foreign Direct Investment and Food security in developing countries

Developing countries (DCs) have a high population growth and food demand. Moreover, foreign direct investment (FDI) is at the heart of investment policy. DCs attract FDI to improve their economic growth. This optimistic view is contradicted by negative effects on their economies. We based our analysis on three important factors: agricultural production, institutional quality and the food import dependency. We investigate the effects of disaggregated and aggregated FDI on the food security. The results show that agricultural FDI improves food security and secondary FDI improves agricultural production through technology transfer and know-how with harmful effects that may occur like the environmental pollution. The tertiary FDI tends to decrease labor in agriculture and to increase food demand in urban areas. By adding the local institution to the analysis, the results show that from certain institutional quality thresholds, primary and secondary FDI improves food security. Our recommendation is that DCs has the interest to improve their institutional quality and target the attraction of FDI. Finally, aggregated FDI tend to deteriorate the ability to import food in low and lower middle income. The latter have an interest to attract export-oriented FDI.

Keywords: Food security; FDI; agricultural production; institution; trade; energy price

Investissements directs étrangers et sécurité alimentaire dans les pays en développement

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A mes parents, Othman et Aïcha

A mes frères, Mohamed Aymen et Housseem

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Glossaire

Abréviation	Définition
3SLS	Three Stage Least Squares
ACP	Analyse en Composante Principale
CADF	Cross-sectionally Augmented Dickey-Fuller
CNUCED	Conférence des Nations Unies sur le Commerce Et le Développement
DCs	Developing countries
CPI	Consumer Price Index
FAO	Food and Agriculture Organization (Organisation des Nations Unies pour l'Alimentation et l'Agriculture)
FDI	Foreign Direct Investment
FAOSTAT	FAO statistics
FMN	Firme multinationale
GDP	Gross Domestic Production
GFCF	Gross Fixed Capital Formation
IDE	Investissement Direct Etranger
IFAD	International Fund for Agricultural Development
GM-maize	Genetically modified maize
GMM	Generalized Method of Moments
INSEE	Institut National de la Statistique et des Etudes Economiques
MDGs	Millennium Development Goals
MNC	Multinational corporation
NPI	Nouveau pays industrialisé
OCDE	Organisation de Coopération et de Développement Economiques
OLS	Ordinary Least Squares
PCA	Principal Components Analysis
PED	Pays en développement
PIB	Produit Intérieur Brut
PVAR	Panel Vector Autoregressive
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
WDI	World Development Indicators
WFP	World Food Programme
WHO	World Health Organization
WTO	World Trade Organization

INTRODUCTION GÉNÉRALE

*Rien n'est possible sans les hommes
rien n'est durable sans les institutions.*¹

Jean Monnet - 1976

Au cours de la période 1995 à 2010, la population des pays en développement (PED)² est passée de 4 484 à 5 603 millions d'habitants, soit 81% de la population mondiale en 2010. Sur cette période, les PED ont un taux de croissance démographique annuel moyen de 1,5% contre 0,6% dans les pays développés³; la demande de produits agricoles et alimentaires⁴ est ainsi élevée, ce qui rend ces pays plus vulnérables en termes de sécurité alimentaire. Jusqu'au début des années quatre-vingt-dix, l'augmentation de production alimentaire semblait la seule stratégie pour éradiquer l'insécurité alimentaire. Toutefois l'évolution de la réflexion économique et sociale a conduit certains auteurs, comme Maxwell (1988) et Drèze et Sen (1990), à considérer que la disponibilité alimentaire n'a aucune valeur pour les individus si ces derniers n'ont pas accès à cette nourriture. Par conséquent, la disponibilité alimentaire ne suffirait pas à assurer la sécurité alimentaire pour tous. Le vrai défi des PED est d'avoir une nourriture disponible, stable et accessible physiquement et économiquement avec une bonne utilisation afin d'améliorer la sécurité alimentaire de leur population.

1. Jean Monnet (1976). Mémoires. éd. Fayard, p. 412

2. D'après la classification de la CNUCED.

3. Les statistiques sont calculées à partir de la base de données de la CNUCED.

4. Selon la classification CTIC, les produits agricoles appartiennent aux sections 0, 1, 2 et 4 moins les divisions 27 et 28. Les produits alimentaires appartiennent aux sections 0, 1, 4 et division 22.

La sécurité alimentaire est un concept très large qui peut être abordée suivant deux approches : microéconomique et macroéconomique. L'approche microéconomique s'intéresse à l'insécurité alimentaire qui touche les ménages et donc les stratégies de mise en œuvre sont principalement des stratégies de survie des individus. L'approche macroéconomique examine les relations qui sont établies entre les grands agrégats économiques et la sécurité alimentaire. L'objectif est de mettre en œuvre des stratégies nationales afin d'assurer la disponibilité alimentaire, de stabiliser l'offre des denrées et de permettre l'accès des individus à cette disponibilité. Ces deux approches sont souvent intégrées dans la stratégie des gouvernements pour combattre l'insécurité alimentaire (Azoulay, 1998).

Pour mesurer la sécurité alimentaire, la littérature propose plusieurs indicateurs (Hoddinott, 1999). La FAO a sélectionné un ensemble d'indicateurs répartis selon les quatre dimensions de la sécurité alimentaire : disponibilité, accès, utilisation et stabilité alimentaire. Pour évaluer la faim et la malnutrition dans les PED, l'indicateur le plus connu dans la littérature économique est l'apport calorique. Cet indicateur qui mesure la disponibilité alimentaire a été critiqué par certains auteurs, comme Jensen et Miller (2010) et Headey et Ecker (2012), à cause de sa faiblesse de réponse face à des chocs des prix des produits alimentaires. En tenant compte des limites de cet indicateur et de la problématique posée, nous utilisons d'autres indicateurs à partir des données de la FAOSTAT. Nos principaux indicateurs sont l'adéquation des disponibilités énergétiques alimentaires, la valeur de la production alimentaire par habitant, la part des disponibilités énergétiques alimentaires provenant des céréales, racines et tubercules, le Produit Intérieur Brut (PIB) par habitant en parité de pouvoir d'achat, l'accès à des sources d'eau et des installations d'assainissement améliorées, la prévalence de l'anémie chez les femmes enceintes et les enfants de moins de 5 ans, et enfin la valeur des importations alimentaires par rapport aux exportations totales de marchandises.

La crise alimentaire de 2008 a montré que l'état de la sécurité alimentaire dans les PED peut être affecté par des facteurs qui ne dépendent pas forcément de leurs économies locales. Par exemple, les spéculations sur les marchés à terme qui ont influencé les variations de prix des produits agricoles et alimentaires, les chocs climatiques comme ceux en Australie (2005-2007) qui ont réduit la production et le commerce du blé à l'échelle mondiale, ou bien les politiques commerciales qui interdisent les exportations de produits alimentaires et qui

encouragent les producteurs à ne pas commercialiser toute leur production (FAO, 2011). Il conviendrait donc de souligner les liens qui existent entre la mondialisation et la sécurité alimentaire. Cette relation concerne en particulier les PED car ils constituent le maillon faible en termes de sécurité alimentaire. En fait, ces pays sont dans une économie mondiale très dynamique et en évolution, où l'ouverture commerciale, la mobilité des capitaux et la volatilité des prix de l'énergie sont devenues les facteurs les plus importants de l'intégration économique et de la dépendance commerciale à l'échelle internationale.

À la recherche de la croissance économique, les PED se tournent vers des ressources de financement externes afin de relancer l'accumulation du capital et d'absorber la connaissance et la technologie transférées par les entreprises étrangères. La présence de ces entreprises dans un marché local génère des effets «*spillovers*». Ces «*spillovers*» peuvent être positifs et/ou négatifs. La participation au capital d'entreprises locales par des entreprises étrangères constitue un canal de transfert technologique et du savoir-faire. Les relations commerciales qui peuvent exister en amont ou en aval permettent aux entreprises locales d'acquérir un savoir-faire en matière de gestion et de communication. Par conséquent, la productivité de ces entreprises s'améliore. Ce qui permet de créer des emplois et d'améliorer les salaires (Javorcik, 2004 ; Mihalache-O'Keef et Li, 2011). En revanche, cette vision optimiste que peuvent avoir certains sur le rôle des IDE est contredite par les «*spillovers*» négatifs et l'augmentation du «*land grabbing*» dans les PED. Les *spillovers* négatifs s'expliquent par des effets néfastes sur l'économie, la société et l'environnement. La présence des entreprises étrangères peut constituer une contrainte d'accès au marché pour les entreprises locales qui ne pouvaient pas supporter la forte concurrence. Certaines activités de production de firmes étrangères peuvent entraîner une pollution de l'environnement, ce qui peut impacter la santé des populations locales. L'IDE peut contribuer à l'accroissement des inégalités. Par exemple, pour attirer la main d'œuvre qualifiée, les entreprises étrangères ont tendance à augmenter les salaires, ce qui entraîne l'élargissement de l'écart salarial avec la main d'œuvre non qualifiée. Un effet démographique peut être constaté lorsque l'IDE dans les services encourage le déplacement des populations rurales vers les villes, ce qui entraîne une baisse de main d'œuvre dans l'agriculture ; d'autre part, la demande de produits alimentaires dans les villes s'accroît et les prix des produits alimentaires augmentent. L'IDE, qui utilise des intrants importés pour produire, peut influencer négativement la balance commerciale et ainsi la capacité à importer (Firebaugh and Beck 1994 ; Javorcik, 2004 ; von Braun et Meinzen-Dick,

2009 ; Mihalache-O'Keef et Li, 2011).

Cependant, une vaste littérature s'est penchée sur les effets des IDE sur les économies d'accueil. Un débat est né entre deux fronts : les partisans de l'attractivité d'IDE et ceux qui s'y opposent. Cette division s'exprime en sociologie par la théorie de la modernisation et celle de la dépendance. Ces deux théories ont influencé les travaux économiques théoriques qui essaient d'expliquer les effets de capitaux étrangers sur le développement et la croissance économique. Empiriquement, la relation entre les flux d'IDE et la sécurité alimentaire a été examinée dans des travaux principalement issus de la sociologie. Les travaux de Firebaugh (1992), Firebaugh et Beck (1994), Jenkins et Scanlan (2001), Wimberley (1991) et Wimberley et Bello (1992) ont utilisé le niveau agrégé de l'IDE, alors que Mihalache-O'Keef et Li (2011) ont utilisé des données désagrégées. En économie, les travaux sur cette relation sont presque inexistants. En fait, les études se sont intéressées aux effets de l'IDE sur le développement et la croissance économique mais pas sur la sécurité alimentaire. En plus, en termes de données utilisées, très peu de travaux empiriques ont fait l'objet de discussion de ces effets par secteur (voir Alfaro, 2003). Concrètement, avec des données agrégées, l'identification de l'effet d'IDE peut amener à une erreur de jugement sur les effets réels qui peuvent exister. En outre, les recherches précédentes ne prennent pas en compte le rôle de l'institution de l'économie d'accueil dans l'absorption de l'IDE.

Dans le cadre de notre étude, nous traitons trois facteurs importants qui sont méconnus dans la littérature empirique existante sur la sécurité alimentaire. Premièrement, l'agriculture est le principal levier de la disponibilité alimentaire. La mobilité des capitaux peut être un complément pour favoriser la production nationale et en particulier la production agricole et alimentaire. Une grande part de leurs effets est expliquée par des «*spillovers*» en termes de création d'emploi, d'hausse de salaires, d'utilisation de nouvelles technologies et de connaissances. Cependant, les pays d'accueil doivent être en mesure d'absorber ces «*spillovers*». Le deuxième facteur est la qualité institutionnelle domestique. La littérature économique reste assez pauvre sur ce sujet. Des économistes tels que North (1990) et Acemoglu *et al.* (2001 ; 2005) considèrent que la qualité institutionnelle est le principal facteur qui explique la performance économique car elle permet de former et d'organiser l'économie. Dans ce cas, la qualité institutionnelle peut influencer l'absorption des «*spillovers*» et ainsi les rendre favorables à la sécurité alimentaire. Troisièmement, le commerce international, qui a évolué

grâce à la libéralisation des capitaux, est toujours sensible à la volatilité du marché de l'énergie. L'évolution technologique et industrielle a rendu l'économie mondiale dépendante aux ressources énergétiques. La littérature existante montre que l'instabilité du marché de l'énergie a influencé les échanges commerciaux (Bridgman, 2008 ; Kousnetzoff *et al.*, 2008 ; Mirza et Zitouna, 2009 ; Turhan *et al.*, 2013). La hausse du prix de l'énergie entraîne l'augmentation des coûts du transport et de production, et conduit ainsi à la hausse des prix des biens échangeables. Les produits alimentaires échangés n'ont pas été épargnés, leurs prix ont augmenté, détériorant ainsi la balance commerciale et la capacité des pays à importer depuis le marché alimentaire international.

Certes, les PED ont des différences géopolitiques et socioculturelles qui influencent les effets de l'IDE et la capacité de les absorber, mais il convient de s'interroger si les flux d'IDE, selon le secteur dans lequel ils sont dirigés, peuvent constituer un levier aux problèmes de l'insécurité alimentaire dans les PED et si les flux entrants d'IDE permettent de générer de recettes en devises pour l'importation alimentaire. Dans cette perspective, nous tentons de vérifier, d'une part, si les flux entrants d'IDE désagrégés permettent d'améliorer les trois dimensions de la sécurité alimentaire à savoir la disponibilité, l'accès et l'utilisation alimentaire dans les PED et d'autre part d'examiner la relation entre les flux d'IDE agrégés et la stabilité alimentaire en tenant compte de l'évolution du prix de l'énergie. Nous proposons quatre chapitres, dont trois empiriques. L'originalité de cette thèse est triple, d'une part, nous évaluons le rôle de l'IDE sectoriel dans l'accroissement de la production agricole et ainsi l'amélioration de la disponibilité et l'utilisation alimentaire. D'autre part, nous investiguons le rôle de la qualité institutionnelle dans l'amélioration de l'effet de l'IDE sectoriel sur l'accès à la nourriture et la lutte contre l'insécurité alimentaire. Enfin, pour compléter notre analyse, nous avons essayé d'apporter des éléments importants sur une question jamais traitée dans la littérature empirique, à savoir la dépendance en importations alimentaires, en examinant l'effet des flux entrants d'IDE et la hausse du prix de l'énergie.

Le premier chapitre permet de mieux comprendre le concept de la sécurité alimentaire. En fait, la littérature comporte de nombreuses définitions ce qui démontre la complexité du concept de sécurité alimentaire. Le caractère multi-dimensionnel de la sécurité alimentaire amène à une multitude de mesures (plus de 450 indicateurs utilisés dans la littérature selon Hoddinott (1999)), ces indicateurs étant déterminés par le contexte de la problématique

en question. Dans cette thèse, nous nous intéressons aux indicateurs macroéconomiques utilisés par la Division des statistiques de la FAO pour trois raisons. D'abord ces indicateurs mesurent les principaux piliers de la sécurité alimentaire selon une vision macroéconomique. Deuxièmement, la majorité des données disponibles couvrent notre période d'étude et elles sont disponibles par pays. Enfin, une corrélation a été mise en évidence entre certains indicateurs, ce qui a permis de construire nos indicateurs composites dans les deuxième et troisième chapitres. Ce premier chapitre propose une analyse descriptive de l'état des lieux des IDE dans les pays en développement.

Le deuxième chapitre est consacré à l'étude de l'amélioration de la disponibilité et l'utilisation alimentaire grâce aux «*spillovers*» générés par l'IDE. L'augmentation de la production agricole est une étape importante vers la croissance de la production de denrées alimentaires et ainsi leurs disponibilités, et donc le principal canal par lequel la sécurité alimentaire s'améliore. Nous construisons un indicateur qui mesure la disponibilité et l'utilisation alimentaires par la technique de l'analyse en composantes principales (ACP). Les indicateurs utilisés sont l'adéquation des disponibilités énergétiques alimentaires, la valeur de la production alimentaire par habitant, l'accès à des sources d'eau et des installations d'assainissement améliorées. Ensuite, et par référence à la littérature, nous déterminons les principaux facteurs macroéconomiques qui peuvent influencer la sécurité alimentaire et la production agricole. La présence d'un biais d'endogénéité entre la sécurité alimentaire et la production agricole nous amène à estimer deux équations simultanées à partir des données d'IDE sectorielles d'un panel non-cylindré de 55 pays en développement sur la période 1995-2009. Les résultats confirment l'idée selon laquelle l'IDE n'a pas un effet unique. Ils suggèrent que l'IDE dans l'agriculture améliore la sécurité alimentaire et les IDE dans les secteurs secondaire et tertiaire augmentent l'insécurité alimentaire. Toutefois, deux effets opposés sont détectés sur la production agricole. Il s'agit des «*spillovers*» positifs et négatifs dus à l'IDE dans le secteur secondaire et le secteur tertiaire.

Le Troisième chapitre met l'accent sur le rôle des institutions nationales dans l'amélioration de l'efficacité des IDE. D'abord, une revue de littérature a permis de souligner l'importance de l'institution dans une économie. Une faible qualité institutionnelle risque de freiner le développement économique et social, et favoriser le dysfonctionnement économique. Une mise en place de structures institutionnelles solides et développées facilite l'investisse-

ment et rend les gouvernements des PED forts face au pouvoir des firmes multinationales (FMN). L'idée est d'examiner les effets des flux entrants d'IDE par secteur selon la qualité institutionnelle, et de tester les effets de l'interaction entre les deux variables sur la performance économique, dans un premier temps, et sur la sécurité alimentaire dans un second temps. Dans ce chapitre nous utilisons deux mesures de sécurité alimentaire. La première mesure est l'indicateur composite utilisé dans le deuxième chapitre. La deuxième mesure est un indicateur composite qui inclut trois indicateurs d'insécurité alimentaire, à savoir, la part des disponibilités énergétiques alimentaires provenant des céréales, racines et tubercules, la prévalence de l'anémie chez les femmes enceintes et la prévalence de l'anémie chez les enfants de moins de 5 ans. Ensuite, en partant de l'idée que l'accès à l'alimentation est le résultat de la performance économique qui est elle-même fondée sur une bonne institution, nous avons mis en lumière l'importance de la bonne qualité des institutions dans l'amélioration de l'effet des IDE sur la sécurité alimentaire en tenant compte des effets d'une mauvaise répartition des revenus sur l'accès à l'alimentation. Notre échantillon varie entre 47 et 57 PED sur la période 1995-2010. Nos résultats suggèrent que l'institution est un élément important pour l'accès économique et physique à la nourriture. En fait, ils montrent que la qualité des institutions influence l'IDE dans les secteurs primaire et secondaire. Les flux d'IDE dans le secteur primaire semblent avoir un impact positif sur le revenu. Cet effet est renforcé quand il y a une interaction avec la présence de bonnes institutions. Concernant les flux d'IDE dans le secteur secondaire, nous avons constaté qu'il n'a d'effet positif, à la fois sur le revenu et sur la sécurité alimentaire, que si la qualité institutionnelle atteint un certain seuil. Cependant, les flux d'IDE dans le secteur tertiaire semblent avoir un effet négatif sur la sécurité alimentaire, même en présence d'une bonne institution.

Le quatrième chapitre se focalise sur la quatrième dimension de la sécurité alimentaire : la stabilité. Nous nous intéressons à l'aspect commercial de la sécurité alimentaire en examinant les liens entre les flux entrants d'IDE et la hausse du prix de l'énergie sur la dépendance en importations alimentaires. Cette dernière est une mesure de la capacité d'un pays à importer de la nourriture en cas de besoin. Par opposition aux autres chapitres, ici, nous utilisons des données agrégées car les données sectorielles à notre disposition ne sont pas compatibles avec la méthodologie de Love et Zicchino (2006) que nous adoptons. Nous estimons un modèle autorégressif en données de panel (PVAR) pour 40 PED sur la période 1990-2010. Nos résultats suggèrent qu'une augmentation des flux d'IDE entrants dans les

pays à revenus faibles et moyens inférieurs et une hausse du prix de l'énergie dans les pays à revenus moyens supérieurs conduisent à plus de dépendance en importations alimentaires.

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Chapitre 1

DES FAITS STYLISÉS ET DES DISPARITÉS RÉGIONALES MARQUANTES

1.1 La sécurité alimentaire : le cadre conceptuel

1.1.1 Un concept évolutif

Depuis l'antiquité, l'humanité a vécu la famine, l'épidémie et/ou une pauvreté extrême durant des années et des vannée. Ces situations expliquent bien l'insécurité alimentaire. Le concept de la sécurité alimentaire n'a vu le jour qu'après la deuxième guerre mondiale. En outre, il est qualifié par son caractère évolutif étant donné que sa définition a évolué depuis 1974. En cette année, la première définition de la sécurité alimentaire a été énoncée lors de la Conférence mondiale de l'alimentation. Dans ce contexte, Smith *et al.* (1992) ont collecté 194 définitions à partir de la littérature académique, les rapports gouvernementaux et des manuscrits non publiés, où ils ont constaté l'évolution du concept de la sécurité alimentaire au cours du temps. Dans le tableau 1.1, il figure une sélection de ces définitions.

C'est au cours du sommet mondial d'alimentation de 1996 que le comité international a adopté la définition finale de la sécurité alimentaire. Cette définition s'est raffinée après quelques années où le mot « social » a été ajouté dans le rapport annuel de la FAO sur l'état de l'insécurité alimentaire dans le monde de 2001 (voir tableau 1.1 et tableau A1). Au cours des sommets suivants en 2002 et 2009, la même définition a été utilisée avec une insistance sur

TABLE 1.1 – Evolution de la définition de la sécurité alimentaire

Auteurs	Définitions
Nations Unis (1975)	Capacité de tout temps d'approvisionner le monde en produits de base, pour soutenir une croissance de la consommation alimentaire, tout en maîtrisant les fluctuations et les prix.
Siamwalla et Valdes (1980)	Capacité d'atteindre des niveaux souhaités de consommation sur une base annuelle.
Valdes et Konandreas (1981)	Une certaine capacité de financer des besoins d'importations pour satisfaire les consommations souhaitées.
FAO (1983)	La sécurité alimentaire consiste à assurer à toute personne et à tout moment un accès physique et économique aux denrées alimentaires dont elle a besoin.
Reutlinger (1985)	L'accès pour tous et en tout temps à une alimentation suffisante pour une vie active et en bonne santé.
Maxwell (1988)	Un pays et un peuple sont en situation de sécurité alimentaire quand le système alimentaire fonctionne de telle sorte qu'il n'y a aucune crainte de ne pas posséder une alimentation suffisante.
Programme Alimentaire Mondial (1989)	La sécurité alimentaire correspond à la capacité pour toute personne de posséder à tout moment un accès physique et économique aux besoins alimentaires de base.
Staatz (1990)	La capacité d'assurer que le système alimentaire fournit à toute la population un approvisionnement alimentaire nutritionnellement adéquat sur le long terme.
Frankenberger et Gooldstein (1991)	La sécurité alimentaire est assurée lorsque la viabilité du ménage, défini en tant qu'unité de production et de reproduction, n'est pas menacée par un déficit alimentaire.
FAO (1996)	La sécurité alimentaire existe lorsque tous les êtres humains ont, à tout moment, un accès physique et économique à une nourriture suffisante, saine et nutritive leur permettant de satisfaire leurs besoins énergétiques et leurs préférences alimentaires pour mener une vie saine et active.
FAO (2001)	Situation caractérisée par le fait que toute la population a en tout temps un accès matériel et socioéconomique garanti à des aliments sans danger et nutritifs en quantité suffisante pour couvrir ses besoins physiologiques, répondant à ses préférences alimentaires, et lui permettant de mener une vie active et d'être en bonne santé.

Source : La traduction est faite par Padilla (1997), et FAO (2003).

Note : Pour consulter le texte original de chaque définition collectée par Smith *et al.* (1992) et les définitions de 1996 et 2001, voir le tableau A1 dans l'Annexe A.

la réduction de la faim et sur l'importance de renforcer la capacité institutionnelle à élaborer et mettre en œuvre des politiques qui garantissent l'accès à la nourriture et qui émettent contre la malnutrition, ainsi qui encouragent l'investissement étranger pour l'agriculture et la sécurité alimentaire dans les pays en développement (PED).

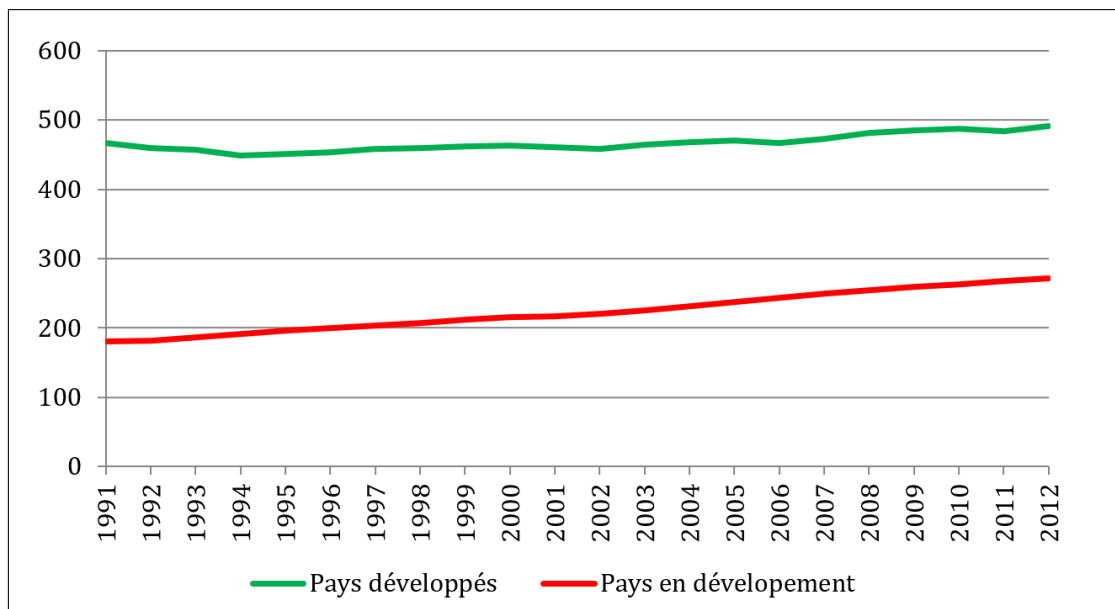
Malgré cette évolution de la définition, complétée au fil du temps, la situation de sécurité alimentaire est toujours prégnante. La définition de 1996 illustre les quatre dimensions de la sécurité alimentaire vers lesquelles les décideurs économiques doivent impérativement orienter leur politique économique et sociale : la disponibilité, l'accès, l'utilisation et la stabilité alimentaire. La division des statistiques de la FAO a collecté un ensemble d'indicateurs permettant de mesurer les quatre dimensions (voir tableau A2 en annexe A).

1.1.2 Les dimensions de la sécurité alimentaire

La disponibilité alimentaire

Le premier pilier de la sécurité alimentaire est la disponibilité alimentaire. Cette dernière est considérée par la FAO (2006) comme « *la disponibilité des aliments en quantité suffisante et d'une qualité appropriée, dont l'approvisionnement est assuré par la production nationale ou les importations (y compris l'aide alimentaire)* ».

FIGURE 1.1 – Comparaison de la valeur de la production alimentaire par habitant entre les pays développés et les PED



Source : Auteur à partir des données de la FAO.

La sécurité alimentaire était pour longtemps considérée comme synonyme à la dispo-

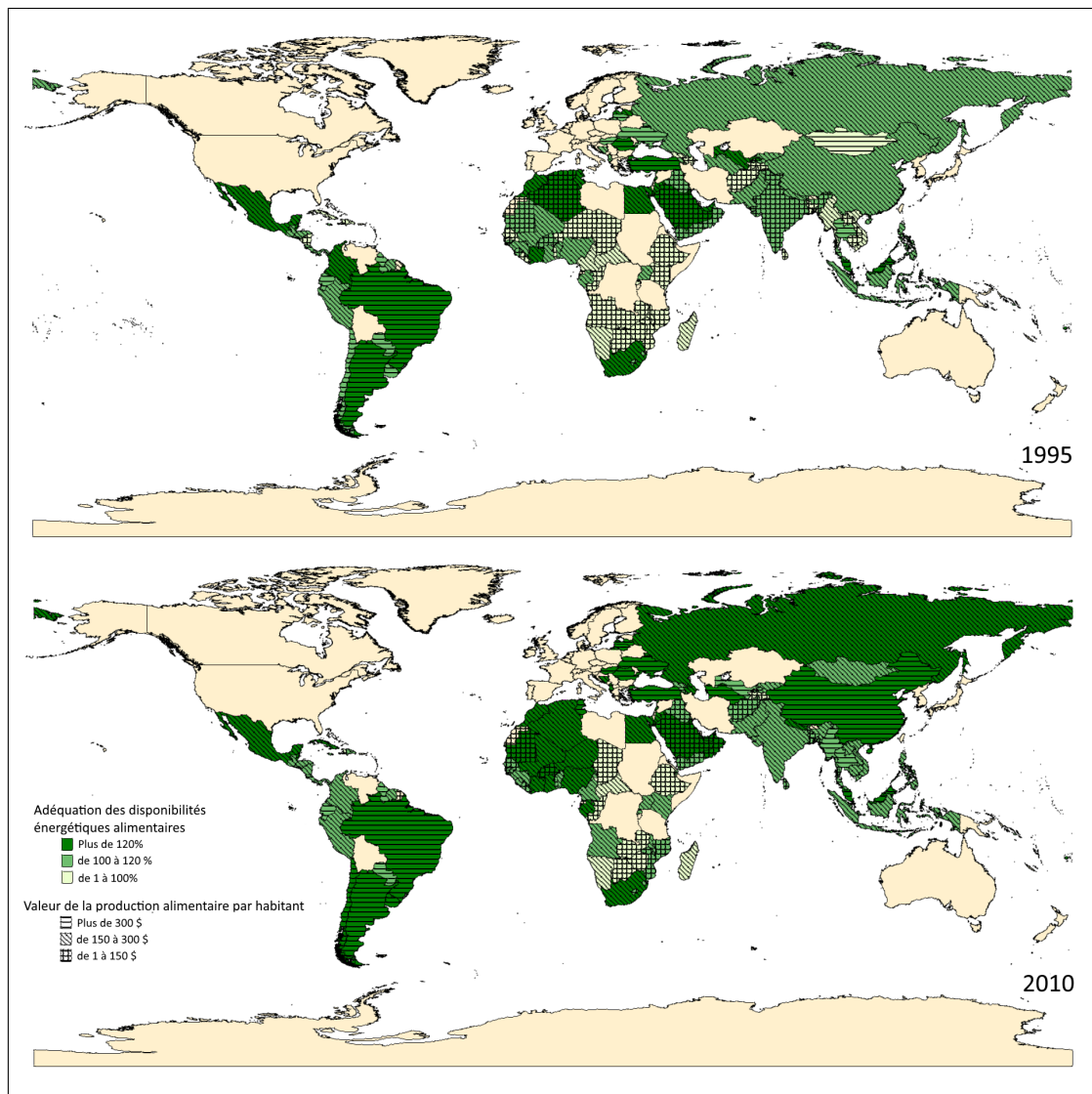
nibilité alimentaire. Après plusieurs années, il s'est révélé qu'avoir une quantité disponible de nourriture n'est pas suffisant ; cela ne signifie absolument pas que cette nourriture soit accessible pour tous. En fait, une augmentation de la production agricole et alimentaire améliore la disponibilité alimentaire. Cependant, cela n'est pas suffisant pour avoir un accès adéquat à la nourriture (Maxwell, 1988 ; Drèze et Sen, 1990 ; Simon, 2012).

Au niveau macroéconomique, la division de la statistique de la FAO utilise cinq indicateurs pour mesurer la disponibilité alimentaire (voir Tableau A2). La Figure 1.1 représente l'évolution de la valeur de la production alimentaire par habitant dans les pays développés et les PED. Sur les vingt-cinq dernières années, la production alimentaire par habitant des PED a crû à peu près linéairement mais elle n'a pas atteint le niveau des pays développés. Au début des années quatre-vingt-dix, les PED ont eu une production par habitant inférieure à celle des pays développés d'environ deux fois. A la fin de la période, la différence s'est légèrement réduite, atteignant 219 dollars (286 dollars en 1991). Cette faible amélioration s'explique par la forte croissance de la population dans les PED par rapport au pays développés.

Un deuxième indicateur s'intitule : adéquation des disponibilités énergétiques alimentaires moyennes. Il correspond à la disponibilité énergétique alimentaire en pourcentage des besoins énergétiques alimentaires moyens ; c'est à dire l'écart entre l'offre et la demande énergétique. Cet indicateur est un bon remplaçant de l'offre de calories, qui est souvent cité dans la littérature, car ce dernier ne reflète pas forcément la disponibilité alimentaire.

La Figure 1.2 présente l'état de la disponibilité alimentaire dans les PED. Nous constatons que l'adéquation des disponibilités énergétiques alimentaires et la valeur de la production alimentaire par habitant se sont sensiblement améliorées en 15 ans si l'on compare les années 1995 à 2010. Les pays, avec un besoin énergétique alimentaire supérieur à leur disponibilité énergétique alimentaire, se trouvent en Afrique et dans le sud de l'Asie. En 1995, la majorité des pays en développement avaient moins de 150 dollars par habitant par an pour la consommation alimentaire. En 2010, cette valeur a dépassé les 300 dollars dans certains pays tels que la Roumanie, la Turquie, la Chine, l'Argentine et le Brésil. Alors que les pays Africains disposent toujours de moins de 300 dollars par habitant.

FIGURE 1.2 – L'adéquation des disponibilités énergétiques et la valeur de la production alimentaire par habitant dans les PED



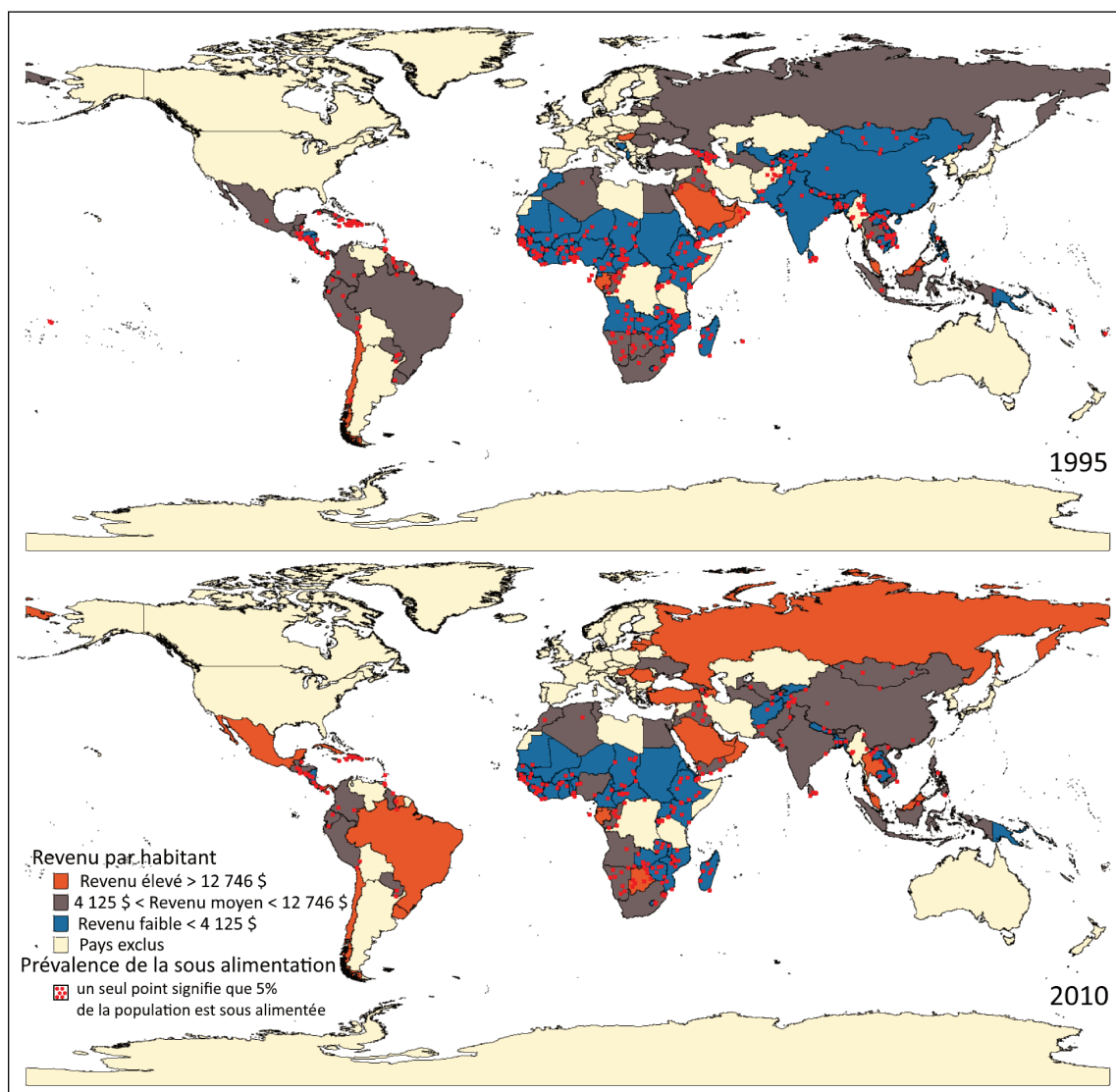
Source : Auteur à partir des données de la FAO.

Note : la disponibilité énergétique alimentaire correspond à l'offre en calories et le besoin énergétique alimentaire correspond au besoin en calories. L'adéquation des disponibilités énergétiques est le rapport entre l'offre et le besoin en calories.

L'accès alimentaire

L'accès alimentaire constitue le deuxième pilier de la sécurité alimentaire et est défini par « *L'accès de tous à des ressources adéquates (droits) leur permettant d'acquérir une nourriture adéquate et nutritive. Les droits sont définis comme l'ensemble de biens auxquels une personne est susceptible d'accéder en raison du contexte juridique, politique, économique et social de la communauté dans laquelle elle vit (y compris certains droits traditionnels*

FIGURE 1.3 – Revenu par habitant et prévalence de la sous-alimentation dans les PED



Source : Auteur à partir des données de la FAO.

Note : Plus il y a de points dans un pays plus la sous-alimentation est propagée dans la population.

tels que l'accès aux ressources communes)» (FAO, 2006). Ce pilier comporte deux éléments importants : l'accès physique et l'accès économique. Le premier concerne, d'une part, la localisation de la nourriture, là où les populations en ont besoin, et d'autre part la facilité d'accéder à la nourriture dans les marchés locaux grâce au développement de l'infrastructure. Quant au deuxième, c'est l'accès économique qui est défini par la capacité financière des populations à satisfaire leurs besoins alimentaires. En outre, un troisième élément, qui s'ajoute au pilier et qui a pu se propulser en un court laps du très proche temps, est lié à l'accès socio-culturel. Il s'agit des contraintes qui peuvent exister à cause des traditions ou

des raisons sociales, aussi bien que la situation de disponibilité alimentaire soit satisfaite et que la nourriture soit à proximité des gens qui en ont besoin (Simon, 2012).

La Figure 1.3 présente le revenu par habitant et la prévalence de la sous-alimentation. Les PED ayant un faible revenu par habitant sont les plus touchés par la malnutrition et inversement les pays avec un revenu élevé sont les moins touchés. Pour que les deux indicateurs se soient améliorés entre les années 1995 et 2010, la sous-alimentation est encore particulièrement persistante chez les populations des pays d'Afrique subsaharienne et du sud de l'Asie.

L'utilisation alimentaire

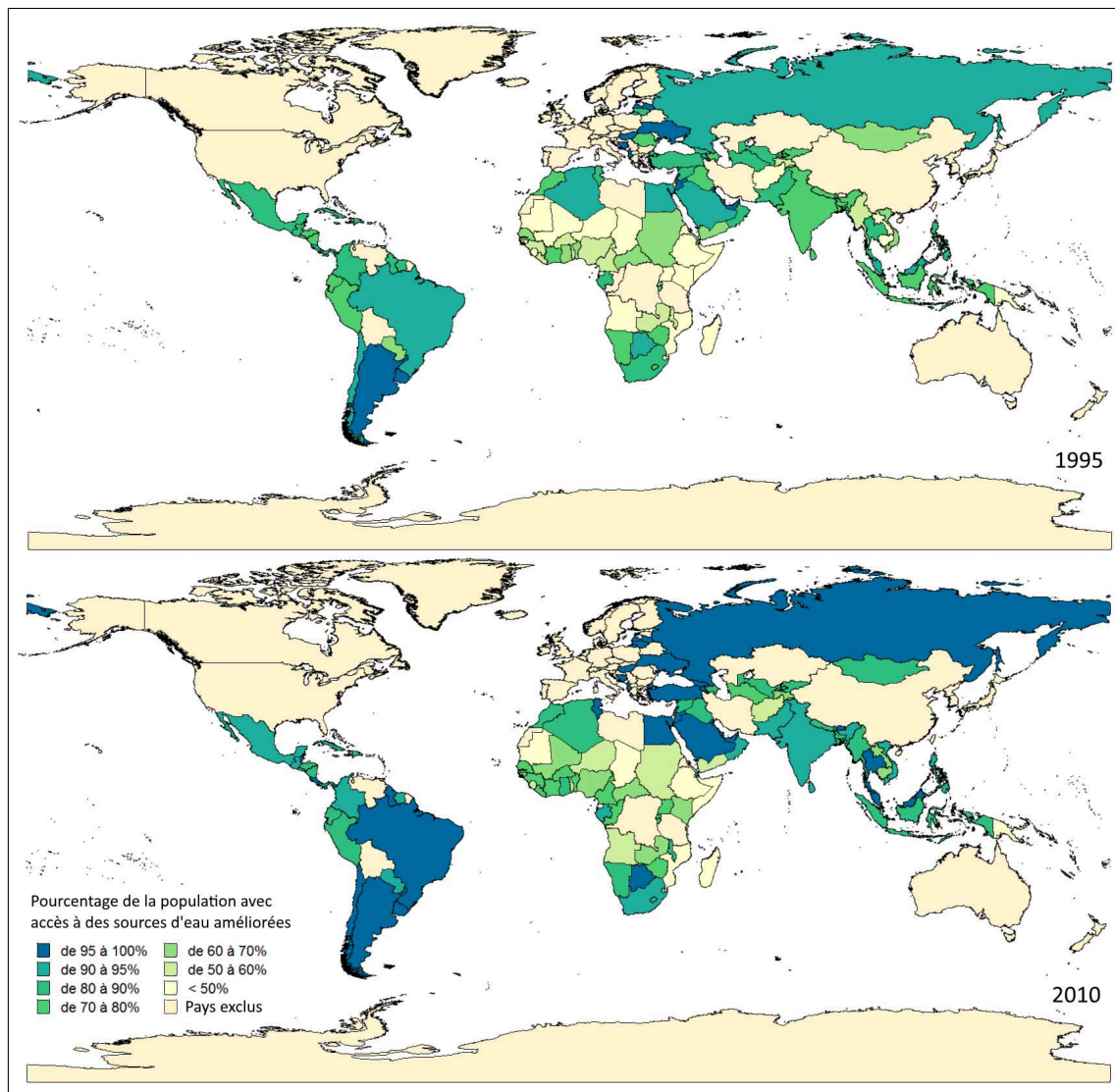
La troisième dimension se réfère à l'utilisation alimentaire. Elle est définie comme « *l'utilisation de la nourriture dans le cadre d'une diète adéquate, d'eau potable, d'assainissement et des soins de santé de façon à obtenir un état de bien-être nutritionnel qui permette de satisfaire tous les besoins physiologiques* » (FAO, 2006).

Cette dimension s'intéresse à la qualité et aux conditions de conservation et d'utilisation des aliments car la bonne alimentation préserve l'état de santé des individus. L'accès à une eau potable et à des installations d'assainissement améliorées est important pour préparer des aliments propres et sains (FAO, 2013).

L'accès à des sources d'eau améliorées¹ dans les PED est représenté sur la Figure 1.4. Nous constatons que l'accès à l'eau a augmenté dans tous les PED entre 1995 et 2010. La majorité des pays d'Afrique et l'Asie du sud sont en retard car ils ne disposent pas de l'infrastructure nécessaire. Notons quelques exceptions telles que la Tunisie, l'Égypte, le Botswana, la Thaïlande, la Malaisie, la Turquie, la Jordanie et la Russie. Dans ces pays, plus de 95% de leur population accèdent à l'eau. En Amérique latine, en Guyane, en Uruguay, au Chili, en Argentine et au Brésil plus de 95% de la population a un accès à des sources d'eau

1. L'accès à une source d'eau améliorée est défini par la Banque Mondiale comme « le pourcentage de la population qui a un accès raisonnable à une quantité suffisante d'eau venant d'une source améliorée telle qu'une prise d'eau ménagère, un réservoir public au sol, un puits, une source ou un puits protégé ou des eaux pluviales collectées. Les sources non améliorées comprennent les vendeurs, les camions-citernes et les sources et puits non protégés. L'accès raisonnable est défini comme étant la disponibilité quotidienne d'au moins 20 litres par personne venant d'une source située dans un rayon d'un kilomètre de l'habitation ».

FIGURE 1.4 – Le Pourcentage de population avec un accès à des sources d'eau améliorées dans les PED



Source : Auteur à partir des données de la FAO.

améliorées. L'amélioration de l'accès à des sources d'eau et des installations d'assainissement réduit un certain nombre de risques sanitaires, notamment la propagation des maladies.

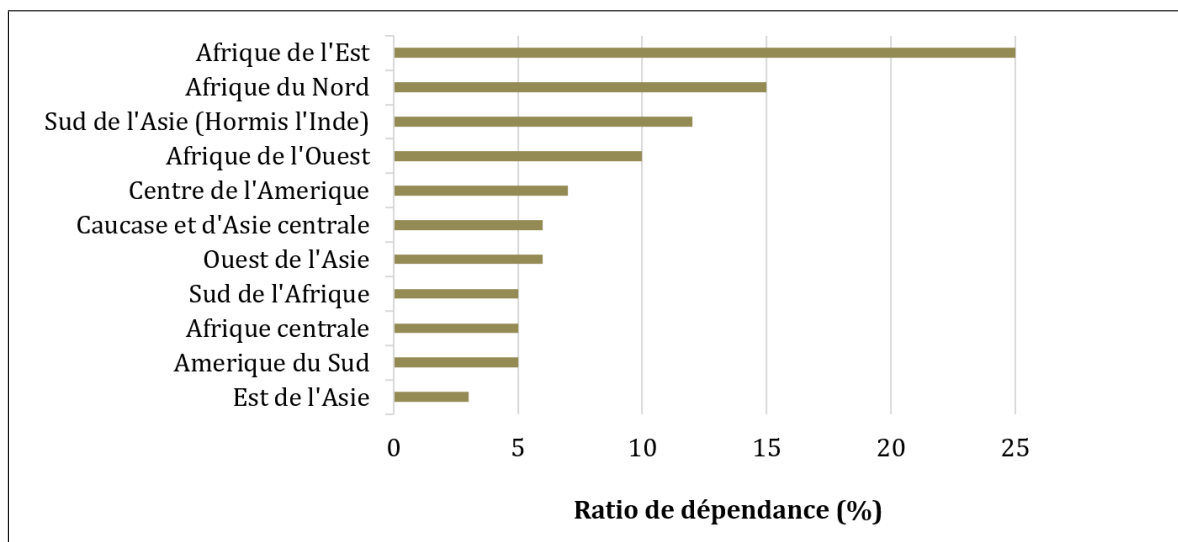
La stabilité alimentaire

Le dernier pilier de la sécurité alimentaire concerne la stabilité. Il se résume par la stabilité des trois autres piliers dans le temps. Selon la FAO (2006), « pour parvenir à la sécurité alimentaire, une population, un ménage ou une personne, doit avoir un accès permanent à

une nourriture adéquate. Cet accès à la nourriture ne doit être menacé ni par l'émergence de chocs soudains (par exemple, une crise économique ou climatique) ou par des événements cycliques (par exemple, une insécurité alimentaire saisonnière). Le concept de stabilité peut donc concerner à la fois la disponibilité et l'aspect lié à l'accès à la sécurité alimentaire. »

Cette dimension se caractérise par un ensemble d'indicateurs qui mesurent la vulnérabilité des pays aux chocs externes. Parmi ces indicateurs macroéconomiques figure la dépendance en importations alimentaire qui est très sensible au commerce international et qui mesure la capacité d'un pays à financer ses importations alimentaires. L'alimentation en question correspond aux marchandises de la section 0 : nourriture et animaux vivants ; la section 1 (boissons et tabac), la section 4 (huiles et graisses végétales et animales), et la division 22 (oléagineux, huile de noix et huile d'amande) de la classification type du commerce international (CTCI). grâce à ses exportations. Face à des chocs des prix de produits alimentaires dans les marchés internationaux, les pays en développement, surtout les importateurs nets de nourriture, ont intérêt à avoir un ratio de dépendance faible.

FIGURE 1.5 – La dépendance en importations alimentaires des PED par région en 2010



Source : Auteur à partir des données de la FAO.

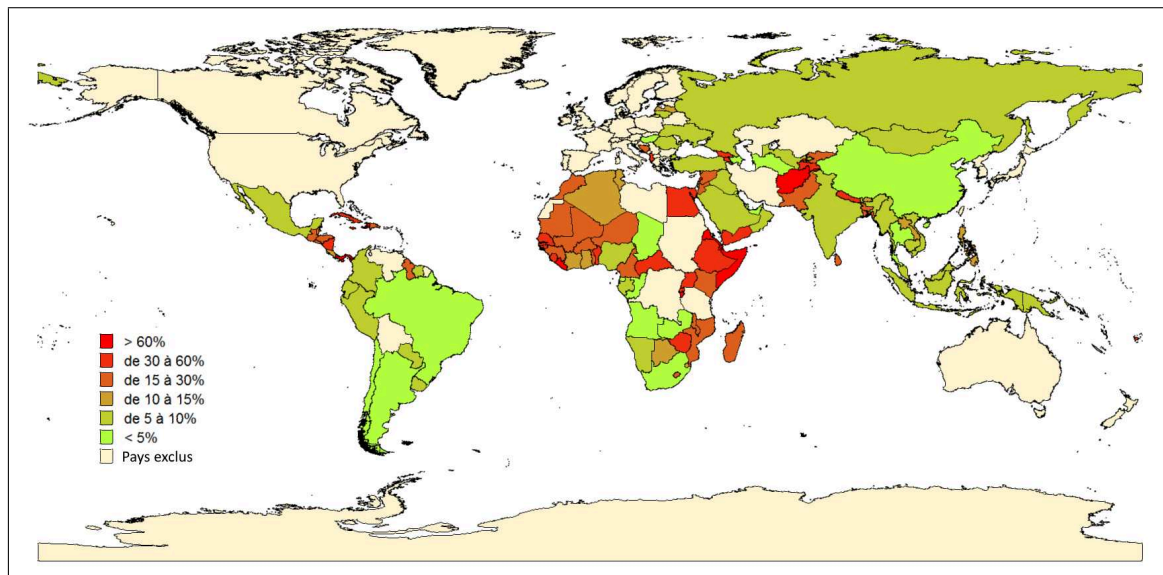
Noter : Le ratio du sud de l'Asie ne prend pas en compte celui de l'Inde car son ratio est le plus faible de la région (5%) ce qui réduit énormément le ratio total.

La Figure 1.5 affiche le taux de dépendance par région. Nous constatons que l'Afrique de l'Est est la plus dépendante avec un ratio de 25%, suivie par l'Afrique du nord, le sud de

l'Asie et l'Afrique de l'Ouest avec des ratios dans un intervalle compris entre 10% et 15%. Les pays les moins dépendants sont les pays de l'Est de l'Asie, de l'Amérique du sud, d'Afrique centrale et celle du sud, avec des ratio compris entre de 3% et 5% . Quant aux autres, leurs ratios sont compris entre 5% et 10%.

D'après la Figure 1.6, cette différence régionale peut être expliquée par certains facteurs importants. Les pays les moins dépendants sont les nouveaux pays industrialisés (NPI) tels que l'Indonésie, l'Inde, la Chine, la Malaisie, la Thaïlande, la Turquie, les Philippines et le Vietnam en Asie ; l'Argentine, le Brésil, le Chili, la Colombie et le Mexique en Amérique du sud et enfin l'Afrique du Sud. Les NPI apparaissent dans une meilleure situation que plusieurs autres pays car leur stratégie d'industrialisation est basée sur la production de biens destinés à l'exportation, ce qui se traduit par une ouverture commerciale plus importante. Cela leur permet d'accroître leurs stocks de devises et de réduire leur dépendance en importations alimentaires.

FIGURE 1.6 – Cartographie de la dépendance en importations alimentaires dans les PED en 2010



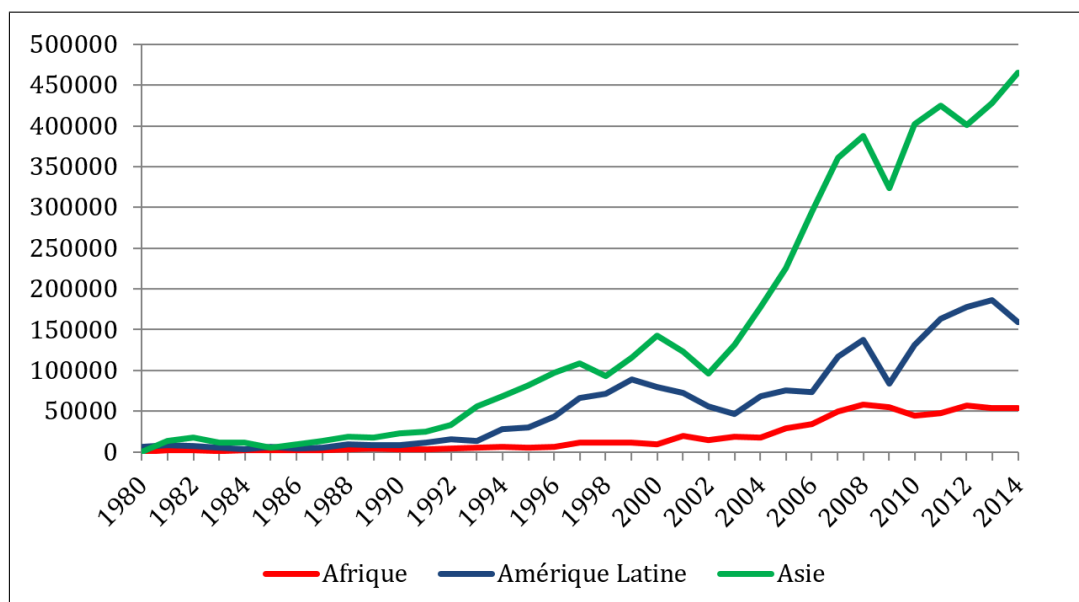
Source : Auteur à partir des données de la FAO.

1.2 L'investissement direct étranger dans les pays en développement

Dans un contexte de mondialisation, l'urbanisation, la hausse du revenu et les flux d'IDE vers les PED sont des facteurs économiques qui influencent la disponibilité alimentaire (FAO, 2004; Kennedy *et al.*, 2004). A la recherche de la croissance économique, les PED attirent des sources de financements étrangers pour accumuler le capital et absorber la connaissance et la technologie. Des organisations internationales telles que l'Organisation de coopération et de développement économiques (OCDE) considèrent l'IDE comme une participation égale au moins à 10 pour cent du capital d'une entreprise dans un pays d'accueil (OCDE, 2010). Les flux d'IDE sont utilisés comme mesure de technologie et de savoir-faire non incorporés qui arrivent de l'étranger vers le pays d'accueil (Blomström *et al.*, 1996).

Les IDE contribuent aussi à l'intégration économique des PED d'accueil dans l'économie mondiale en stimulant les échanges avec les économies développées et en permettant de promouvoir leurs produits plus largement sur les marchés internationaux.

FIGURE 1.7 – Evolution des flux entrants d'IDE dans les PED (millions de \$, prix courants)



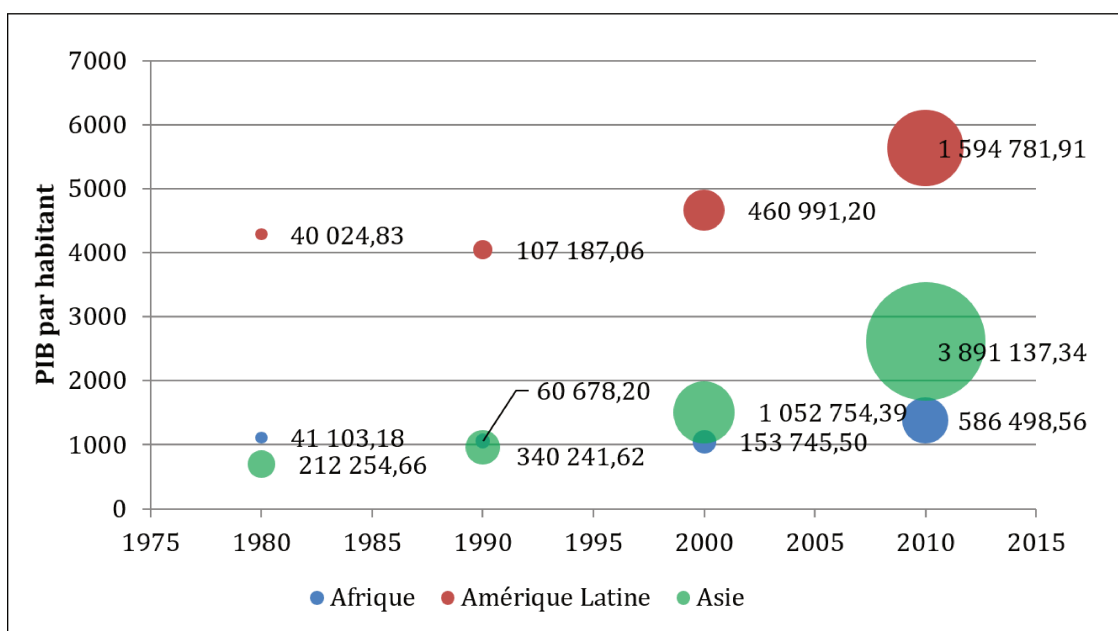
Source : Source : Auteur, d'après la base de données de CNUCED.

La Figure 1.7 montre l'évolution des flux d'IDE entrants dans les pays en développement en Afrique, en Asie et en Amérique Latine. Depuis le milieu des années quatre-vingt, les

flux d'IDE ont connu un accroissement rapide, quelque soit le continent, due principalement à la libéralisation commerciale et les mouvements des capitaux (Reardon et Hopkins, 2006). Néanmoins, l'Asie est la région la plus attractive d'IDE, l'Afrique demeure la moins attractive.

Les flux sont sensibles à l'état de l'économie internationale. La Figure 1.7 met en évidence au moins deux périodes durant lesquelles les flux d'IDE ont chuté en Asie et en Amérique Latine. Ces deux périodes coïncident avec 2 crises majeures de la décennie 2000. La première est la crise internet en 2000 suivie du choc des attentats du 11 septembre 2001. la deuxième est la crise des surprimes en 2007-2008. Selon les trois courbes, il est clair que l'Afrique est la moins intégrée dans l'économie mondiale, et c'est la raison pour laquelle cette région est la moins affectée par les crises. Une autre raison peut être que les IDE en Afrique sont en majorité dans le secteur des ressources naturelles où la demande était élevée durant ces périodes de crises.

FIGURE 1.8 – Evolution du stock d'IDE entrants et le PIB par habitant entre 1980 et 2010 dans les PED (millions de \$, prix courants)



Source : Source : Auteur, d'après la base de données de CNUCED.

En termes de stocks d'IDE, la même tendance est observée. Le Figure 1.8 décrit l'évolution dans le temps du stock des IDE entrants et du produit intérieur brut (PIB) par habitant selon la disparité régionale des PED. L'axe horizontal indique le temps, l'axe

vertical indique le niveau du PIB par habitant et la taille des bulles indique le stock d'IDE : plus la bulle est importante, plus le stock est élevé.

On peut constater que de 1980 à 2010 les PED Asiatiques ont conservé leur première place comme ayant le plus grand stock d'IDE par rapport aux autres pays. Le stock d'IDE est plus faible dans les pays Africains. Par contre, ce stock élevé d'IDE dans les PED Asiatiques ne leur a pas permis de rattraper les PED d'Amérique Latine qui ont un PIB par habitant supérieur. L'évolution croissante du stock d'IDE est suivie par une croissance dans le PIB par habitant dans les trois régions mais avec une plus faible croissance pour l'Afrique. Ces évolutions des stocks d'IDE se traduisent par l'intégration de ces pays dans l'économie mondiale et l'amélioration de leur activité économique domestique.

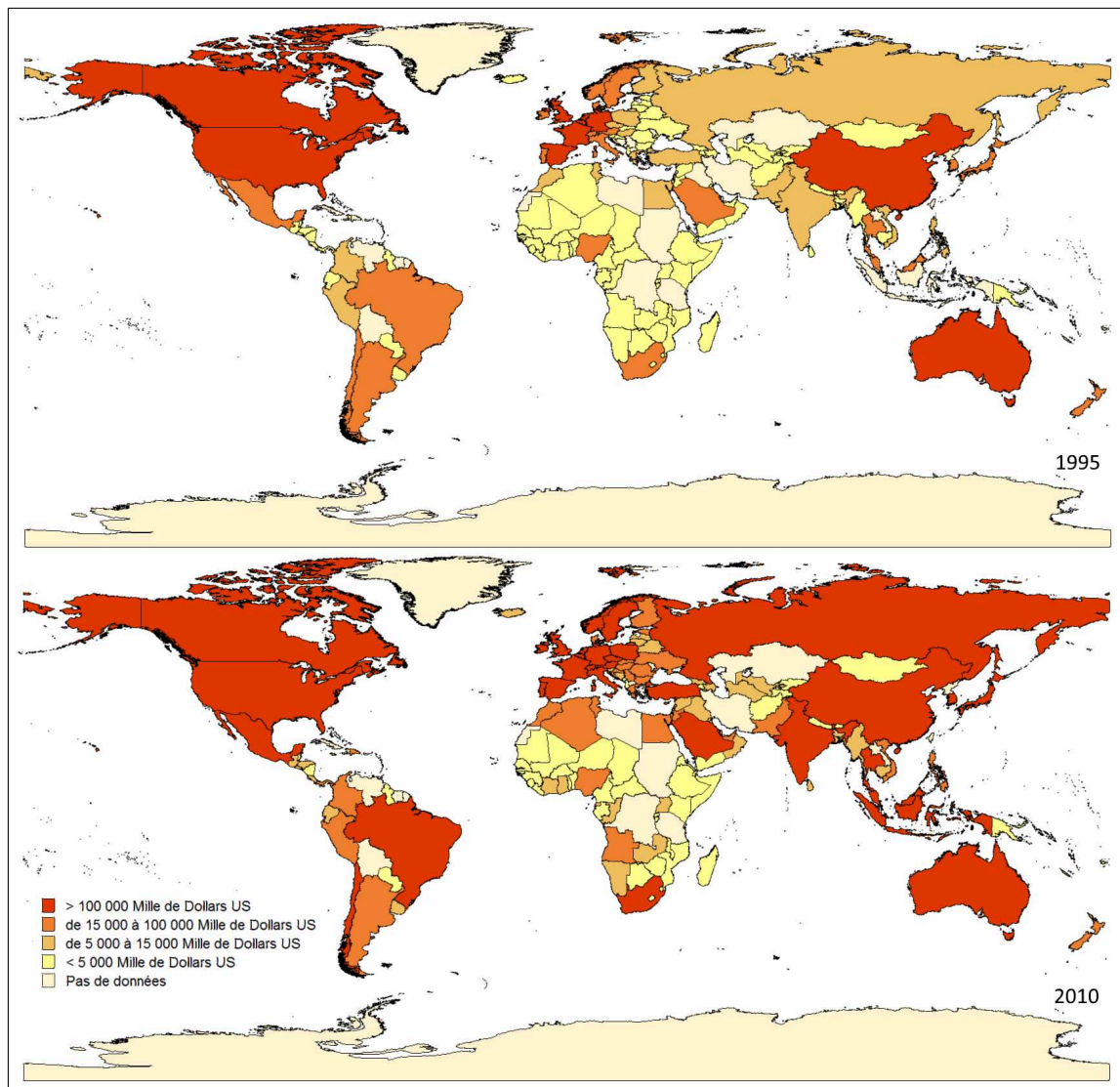
Pour avoir une image plus claire et plus large sur la localisation des stocks d'IDE dans le monde, la Figure 1.9 cartographie la situation pour deux années 1995 et 2010. Il apparaît clairement que les IDE sont accumulés dans les pays du nord alors que le stock est beaucoup plus faible dans les pays du sud. En 1995, la seule exception est la Chine avec un stock d'IDE de plus de 100 milliards de dollars. Les flux d'IDE sont particulièrement faibles en Afrique.

1.2.1 Les Investissements Directs étrangers désagrégés

Compte tenu de notre problématique cherchant à expliquer la relation entre les IDE et la sécurité alimentaire, il nous est apparu nécessaire de s'intéresser aux IDE selon les secteurs d'activité : primaire, secondaire et tertiaire. Très peu d'études se sont penchées sur cette désagrégation.

Après des mois d'investigation, nous sommes parvenus à obtenir des IDE sectoriels auprès de la Conférence des Nations Unies sur le commerce et le développement (CNUCED). Bien que les données ne soient pas disponibles pour tous les pays, nous avons pu rassembler les données de 18 pays pour évaluer la répartition des flux d'IDE selon le secteur d'activité (Figure 1.10). Le secteur tertiaire (les services) est le plus attractif en termes d'IDE avec une part qui dépasse les 45% en 2006 et 2008. Vient ensuite le secteur secondaire avec une part qui varie entre 40% et 28%. Le secteur primaire est le moins attractif avec une part qui ne dépasse pas 26%, mais cette part a augmenté en 2006 et 2008 relativement aux années passées.

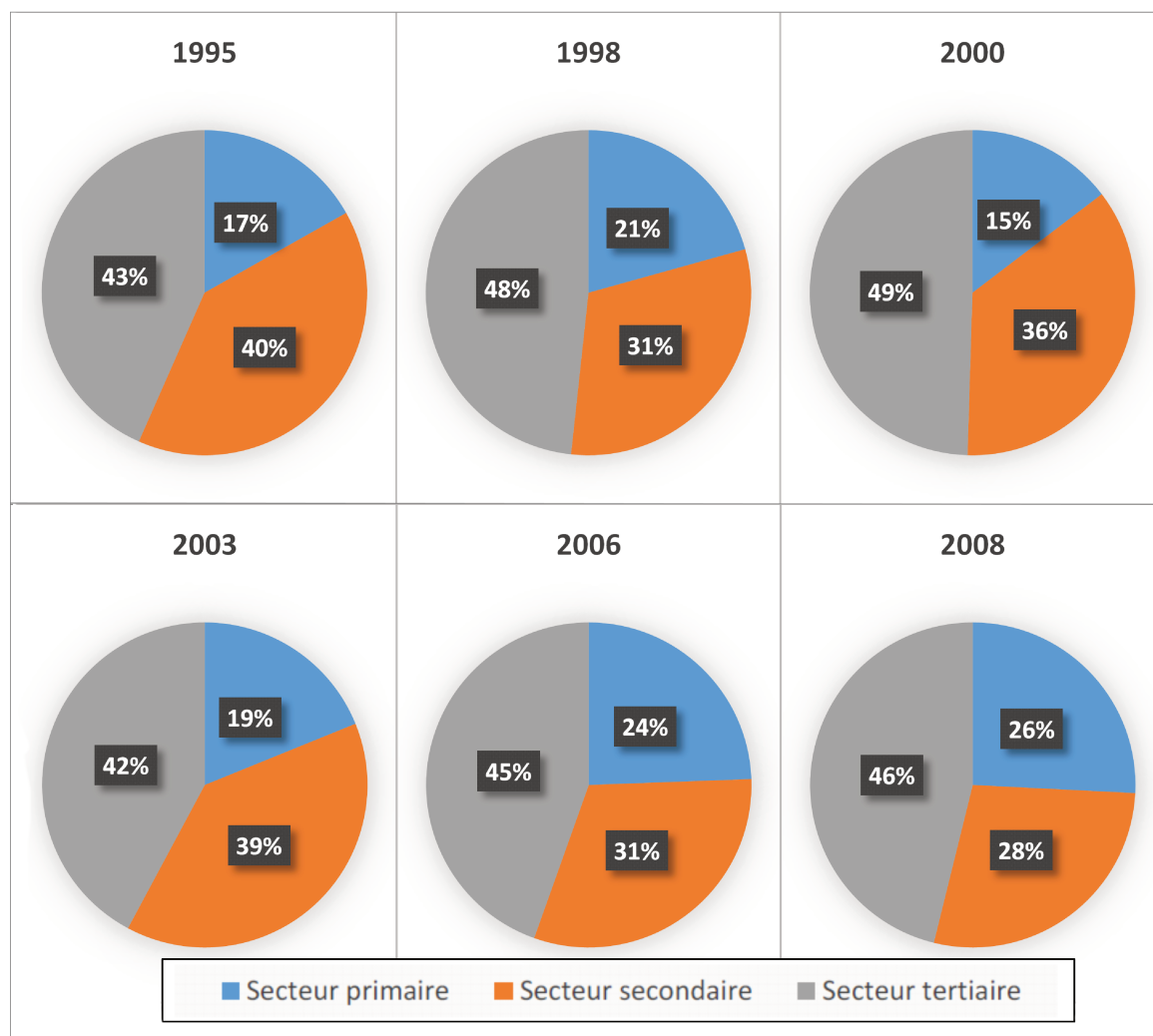
FIGURE 1.9 – La localisation des stocks entrants d'IDE dans le monde



Source : Source : Auteur, d'après la base de données de CNUCED.

Selon la disponibilité des données, la moyenne des flux d'IDE entrants par secteur est calculée sur deux périodes successives (Figure A1 en Annexe A). La première période s'étale de 1995 à 2002 et la deuxième période est entre 2003 et 2010. Il ressort une grande disparité régionale des flux d'IDE dans les pays en développement. Certains pays comme le Brésil et la Colombie en Amérique du sud, et la Russie en Asie sont les plus attractifs en termes d'IDE primaires durant la deuxième période. Cependant, la baisse observée pour l'Argentine peut être expliquée par les répercussions de l'instabilité économique connue entre 1999 et 2002.

FIGURE 1.10 – La répartition des flux entrants d’IDE selon le secteur d’activité dans 18 pays en développement



Source : Auteur, d’après la base de données de CNUCED.

Note : Les pays sont : Argentine, Azerbaïdjan, Bangladesh, Bolivie, Chili, Colombie, Costa Rica, Equateur, Honduras, Mexique, Nicaragua, Pakistan, Paraguay, Pérou, Philippines, Thaïlande, Trinidad et Tobago et Tunisie.

Les flux d’IDE dans le secteur secondaire en Asie et en Europe de l’Est ont augmenté, dépassant les 3000 millions de dollars US après 2002. Les principaux pays concernés sont la Roumanie, la Russie, l’Inde, l’Arabie Saoudite et la Chine. Enfin, la répartition des flux dans le secteur tertiaire ne montre pas un grand changement comparé au secteur secondaire, mais ce secteur est le plus attractif en matière d’IDE comparé aux autres secteurs.

Les ressources naturelles, le prix de la main d’œuvre, la stabilité économique et sociale sont des facteurs primordiaux pour attirer les IDE. Les flux d’IDE en Afrique sont

généralement dans le secteur des industries extractives. Par exemple, les IDE reçus par la Tunisie sur la période 2000 et 2006 dans le secteur primaire présentent 60,9% du total d'IDE dont 60,4% dans le secteur des industries extractives. Le reste se répartit comme suit : 25,7% pour l'industrie manufacturière et 13,4% pour les services (Banque mondiale, 2014).

1.2.2 Les firmes multinationales sont des sources d'IDE

Définition et mesure

Les firmes multinationales (FMN) sont des sociétés dont les activités dépassent le pays où la tête du groupe est implantée (INSEE, 2014). L'OCDE (2010) les a nommées des entreprises d'investissement direct et les a qualifiées par *des sociétés qui peuvent être des filiales dont l'investisseur détient plus de 50% des droits de vote ou des entités associées, dans lesquelles l'investisseur détient entre 10% et 50% des droits de vote ou encore des quasi-sociétés comme des succursales*. La mesure de l'activité de ces firmes est très compliquée et il n'existe pas une base de données qui retrace l'activité réelle des FMN. C'est pour cette raison, dans la littérature économique, les données d'IDE² sont souvent utilisées pour tracer l'activité de ces firmes bien qu'elles ne soient pas la bonne approximation car les statistiques comprennent les relations financières intra-groupes ce qui rend la progression enregistrée dans les statistiques biaisée (Fontagné et Toubal, 2010).

Citons à titre d'exemple, ces erreurs de calcul et manque d'information qui ont déjà été constaté par Duce (2003), où l'auteur a comparé deux sources des données, celle de la CNUCED et celle du Fond Monétaire International (FMI) sur la période 1980-2001. Elle a trouvé que les données CNUCED relatives au stock d'IDE dans les PED sont largement supérieures aux données du FMI. Cette différence est beaucoup moins large lorsque les données sont mesurées en flux. En outre, ce sont les flux d'IDE qui sont le plus souvent utilisés dans la littérature empirique (par exemple, Blomström *et al.*, 1996 ; Borensztein *et al.*, 1998 ; de Mello, 1997 et 1999 ; Carkovic et Levine, 2002 ; Bengoa et Sanchez-Robles, 2003 ; Alfaro *et al.*, 2004 ; Li et Liu, 2005).

2. Les organisations internationales telles que CNUCED, FMI, OCDE et Eurostat collectent les données d'IDE à partir des statistiques de balances de paiements des pays qui sont disponibles à travers le temps, par secteur industriel et par pays de réception et pays d'origine (Navaretti et Venables, 2004 ; Fontagné et Toubal, 2010).

Les FMN et la sécurité alimentaire

Les FMN sont à la recherche du profit qui est devenu très limité dans leur pays de domicile à cause de la concurrence et la stagnation de marchés locaux. Les marchés des pays en développement représentent une cible pour ces investisseurs car les opportunités de réaliser des profits sont plus importantes (Reardon *et al.*, 2003). En même temps, les PED sont à la recherche de capitaux pour acquérir un savoir-faire et un transfert technologique qui leur permette de favoriser la croissance économique. Lorsque les FMN s'implantent dans les pays d'accueil, elles apportent une certaine technologie exclusive qui leur permet de rivaliser les firmes locales. Aussi, les FMN sont plus compétitives en termes du marketing et dans la capacité d'exploiter et de bénéficier de l'avantage comparatif des pays d'accueil. Cela implique des changements dans le marché local puisque les firmes locales vont essayer de protéger leur part de marché et donc de rattraper les entreprises étrangères (Blomström et Kokko, 1998 ; Javorcik, 2004). Ces effets que la littérature nomme « *spillovers* » touchent indirectement l'économie du pays d'accueil et ainsi la sécurité alimentaire.

Les FMN ont contribué à l'implantation des restaurants « Fast-food » et des grands supermarchés où le consommateur trouve une variété alimentaire plus importante avec des prix compétitifs (Reardon *et al.*, 2003). Toutefois, les FMN représentent aussi des inconvénients. Dans ce contexte, quelques exemples peuvent illustrer les effets de l'IDE. Prenant l'exemple de Monsanto, une FMN spécialisée dans les biotechnologies agricoles, qui a enregistré un chiffre d'affaires en 2012 de 13,5 milliards de dollars, plus que le PIB de certains pays en développement. Cette FMN a obtenu des brevets sur la modification génétique des plantes. Une méthode qui lui a permis de contrôler la nourriture dans le monde (Robin, 2008 ; p329). La Tunisie par exemple a gagné en terme d'augmentation de productivité de la terre suite à l'utilisation de semences améliorées (Banque mondiale, 2006) ; par contre elle a perdu ses variétés locales. Une autre entreprise, Union Carbide, une FMN Américaine spécialisée dans la fabrication et la distribution des produits chimiques, a été la cause de la « catastrophe de Bhopal » où eut le décès de vingt mille personnes après des semaines de la propagation d'un gaz mortel sur la ville Indienne dans la nuit de 2 au 3 décembre 1987 (Robin, 2008 ; p330). D'autres types de « *spillovers* » négatifs existent lorsque les entreprises étrangères importent des intrants pour produire au lieu d'utiliser les intrants locaux. Dans ce cas, les fournisseurs locaux ne seront pas en mesure de bénéficier de l'économie d'échelle potentielle (Blomström et Kokko, 1998), et ainsi la balance commerciale s'entravera.

Alors qu'empiriquement plusieurs travaux ont étudié la relation entre les IDE et la croissance, les conclusions sont divergentes. Certains considèrent que les IDE sont affectés positivement par la croissance économique comme par exemple l'étude qui porte sur l'Inde de Chakraborty et Basu (2002) où ils ont trouvé une relation unidirectionnelle allant du PIB vers les flux d'IDE entrants. Alors que pour d'autres, sous certaines conditions, les IDE peuvent influencer la croissance : Borensztein *et al.* (1998) montrent pour un échantillon de 69 pays en développement, qu'à partir d'un certain seuil la variable du capital humain, ces pays peuvent bénéficier positivement de l'IDE. La présence des FMN dans les économies d'accueil peut être bénéfique grâce aux «*spillovers*» positives sous forme de transfert technologique, de savoir-faire, d'amélioration du capital humain et d'intensification de la concurrence. Pour garder leur place sur le marché, les entreprises locales vont essayer de rattraper les entreprises étrangères en devenant plus compétitives. D'autres facteurs peuvent expliquer comment l'économie locale est influencée, tel que le déplacement de la main d'œuvre des entreprises étrangères vers les entreprises locales, la création de nouvelles entreprises par des ex-salariés des entreprises étrangères, le nouement des relations commerciales entre les entreprises étrangères et les entreprises locales.

Par contre, Mencinger (2003) a trouvé un effet négatif de l'IDE sur la croissance économique en utilisant un panel de huit pays³ sur la période de 1994-2001. Il explique ces résultats par la nature des IDE dans l'échantillon qui est en général une fusion-acquisition entre les firmes, ce qui provoque l'importation et donc le déficit du compte courant. La faiblesse de firmes locales face à la forte compétitivité des firmes étrangères cause donc leur sortie du marché et ainsi la baisse de la production nationale.

Cette ambiguïté dans les effets de l'IDE a poussé certains économistes à comprendre plus profondément le rôle des IDE par l'utilisation des données désagrégées comme par exemple Wang (2009) qui a utilisé des données d'IDE désagrégées pour 12 économies⁴ asiatiques au cours de la période 1987-1997. Il a trouvé que l'IDE dans le secteur manufacturier est plus bénéfique pour la croissance économique que dans les secteurs non manufacturiers.

3. Les pays sont la République tchèque, l'Estonie, la Hongrie, la Lettonie, la Lituanie, la Pologne, la Slovaquie et la Slovénie. Ces pays se caractérisent par leur forte dépendance en IDE avant leur adhésion progressive à l'Union Européenne.

4. Les pays sont le Bangladesh, la Chine continentale, Hong Kong, l'Inde, l'Indonésie, la Corée, la Malaisie, le Pakistan, les Philippines, Singapour, la Thaïlande et Taiwan.

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Annexe A

TABLE A.1 – Texte original de quelques définitions de la sécurité alimentaire

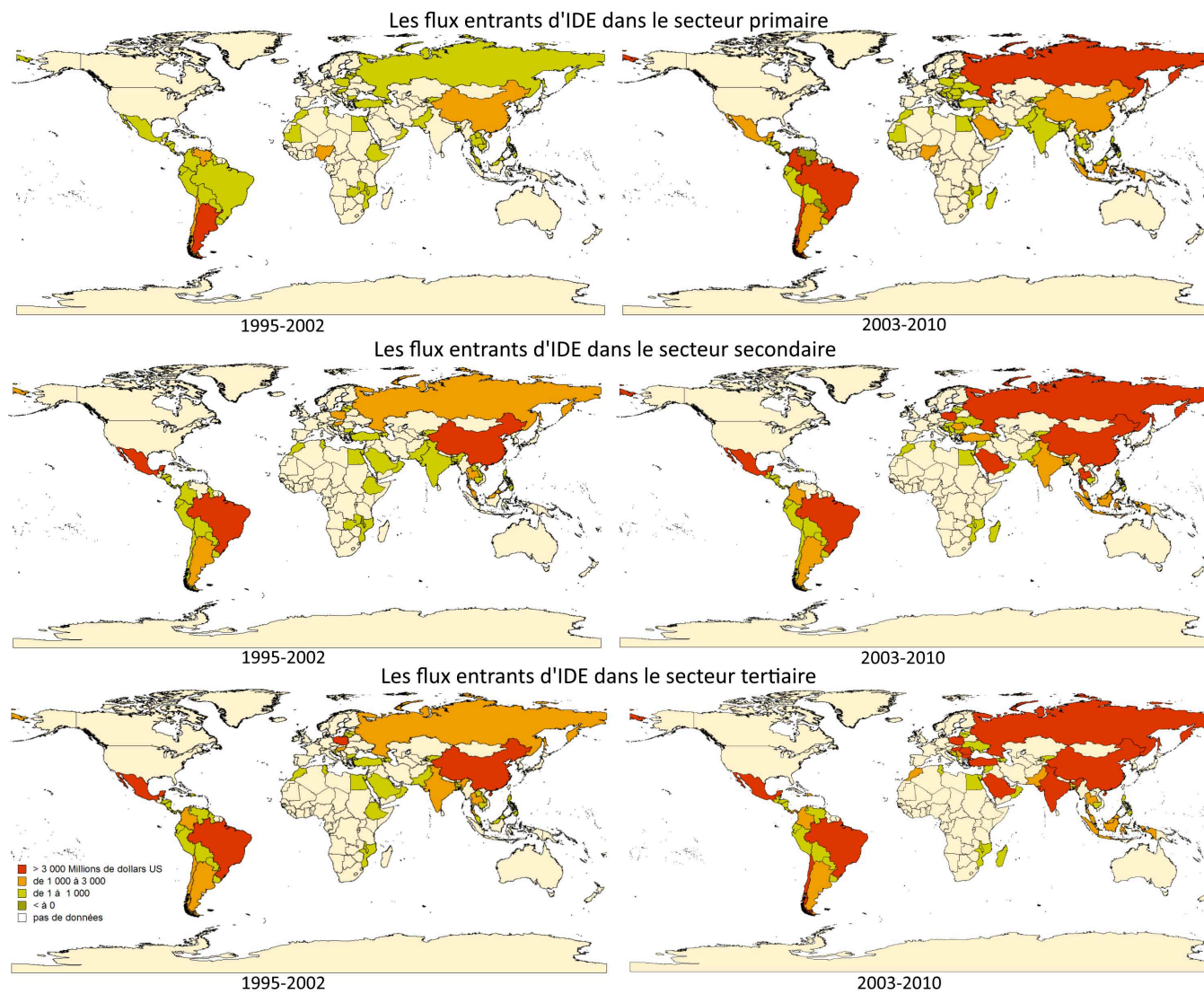
Auteur	Définition en anglais
FAO (1983)	Food security is ensuring that all people at all times have both physical and economic access to the food they need.
Frankenberger and Gooldstein (1991)	Food insecurity is when the viability of the household as a productive and reproductive unit is threatened by food shortage.
Mawxell (1988)	A country and people are food secure when their food system operates in such a way as to remove the fear that there will not be enough to eat.
Reutlinger (1985)	Food security is defined as access by all people at all times to enough food for active and healthy life.
Siamwalla and Valdes (1980)	Food security may be defined as the ability of food-deficit countries, or regions or households within these countries, to meet target levels of consumption on a yearly basis.
Staatz (1990)	Food Security is the ability of a country or a region to assure, on a long-term basis, that its food system provides the total population access to a timely, reliable, and nutritionally adequate supply of food.
United Nations (1975)	Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices.
Valdes and Konandreas (1981)	Food security in developing countries is the uncertain ability to finance needed imports to meet immediate targets for consumption levels. There are two main causes of food insecurity : shortfalls in domestic production and sudden fluctuations in the prices of food imports and national food or non-food exports.
WFP (1989)	Food security refers to the sustained ability of all people to have physical and economic access to their basic food consumption needs at all times.
FAO (1996)	Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.
FAO (2001)	A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

TABLE A.2 – Les indicateurs macroéconomiques de la sécurité alimentaire

Dimension	Indicateurs
Disponibilité	<ul style="list-style-type: none"> ▷ Adéquation des disponibilités énergétiques alimentaires moyennes ▷ Valeur moyenne de la production alimentaire ▷ Part des disponibilités énergétiques alimentaires provenant des céréales, racines et tubercules ▷ Disponibilités protéiques moyennes ▷ Disponibilités protéiques moyennes d'origine animale
Accès	<ul style="list-style-type: none"> ▷ Pourcentage des routes revêtues sur l'ensemble du réseau ▷ Densité du réseau routier ▷ Densité du réseau ferroviaire ▷ Produit intérieur brut par habitant (en parité de pouvoir d'achat) ▷ Indice national des prix des produits alimentaires ▷ Prévalence de la sous-alimentation ▷ Part des dépenses alimentaires chez les populations pauvres ▷ Ampleur du déficit alimentaire ▷ Prévalence de l'insuffisance alimentaire
Stabilité	<ul style="list-style-type: none"> ▷ Taux de dépendance à l'égard des importations céréalières ▷ Pourcentage des terres arables équipées pour l'irrigation ▷ Valeur des importations alimentaires par rapport aux exportations totales de marchandises ▷ Stabilité politique et absence de violence/terrorisme ▷ Instabilité des prix intérieurs des produits alimentaires ▷ Variabilité de la production alimentaire par habitant ▷ Variabilité des disponibilités alimentaires par habitant
Utilisation	<ul style="list-style-type: none"> ▷ Accès à des sources d'eau améliorées ▷ Accès à des installations d'assainissement améliorées ▷ Pourcentage des enfants de moins de 5 ans émaciés ▷ Pourcentage des enfants de moins de 5 ans présentant un retard de croissance ▷ Pourcentage des enfants de moins de 5 ans présentant une insuffisance pondérale ▷ Pourcentage des adultes présentant une insuffisance pondérale ▷ Prévalence de l'anémie chez les femmes enceintes ▷ Prévalence de l'anémie chez les enfants de moins de 5 ans ▷ Prévalence de la carence en vitamine A dans la population ▷ Prévalence de la carence en iode dans la population

Source : Site web de la Division des statistiques de la FAO.

FIGURE A.1 – Évolution des flux entrants d'IDE par secteur d'activité



Source : Cartes construites par l'auteur avec des données de la FAOSTAT

Chapitre 2

THE ROLE OF SECTORAL FDI IN PROMOTING AGRICULTURAL PRODUCTION AND IMPROVING FOOD SECURITY

2.1 Introduction

*Food security is a big challenge to the economic decision-makers in developing countries (DCs) and it is closely linked to social stability in these areas, where poverty can reach very high levels. According to the State of Food Insecurity in the World's report of FAO, IFAD, WFP (2013), nearly 842.3 million people (12 percent of the world population) are chronically undernourished; the vast majority lives in developing countries.

The economic and social potential of developing countries does not necessarily lead to good results in improving food security. In fact, it faces to a global economic context, which is characterized by changes in growth, commodity prices, climate and trade. The World Bank (2008) as well as the FAO, WFP and IFAD (2012) show that agricultural investment plays an important role in promoting agricultural growth, reducing poverty and hunger. Liu (2014) summarizes the results of FAO's case studies on the impacts of foreign agricultural

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investment on host communities and countries.¹

The recourse to the attraction of foreign direct investments (FDI) can be an alternative for developing countries. The FDI inflows have grown greatly in these countries, from 16.7 percent of global inflows in the early 1990s to 52 percent in 2012. Among them, the lowest share is directed to Africa and the biggest share is directed to the East and the Southeast of Asia (UNCTAD, 2013).

According to these stylized facts, a positive relationship between FDI inflows and the food supply is expected. In fact, the empirical literature dealing with the impact of FDI on food security dates back to the 1980s. The focus was on the distinction between the dependency and the modernization effects. Indeed, foreign investments could play a positive role via their effect on agricultural productivity (Hallam, 2011) but they are also a source of economic and political dependency (Jenkins and Scanlan, 2001 ; Wimberley, 1991). As far as we know, a number of empirical studies have used the aggregated FDI inflows (see Wimberley, 1991 ; Firebaugh, 1992 ; Firebaugh and Beck, 1994 ; Jenkins and Scanlan, 2001). The sectoral approach of FDI is rarely used and when it is used, it concerns rather developed countries. In addition, the spillover effect of FDI has been seen in intra-industry rather than in inter-industry (Vu and Noy, 2009). So, there is a lack in the literature about this relation when we are focusing on sectoral FDI in developing countries. Another limit in the existing empirical works is the neglect of agricultural production, which is the main base of food security.

To our best knowledge, at disaggregated level, only Mihalache-O'Keef and Li (2011) analyzed the direct economic relationship between sectoral FDI and food security in a large sample. Djokoto (2012) investigated the effects of FDI on food security in one particular developing country, Ghana. On the other hand, a large economic literature deals with FDI spillovers. At the sectoral level, we could cite a recent work of Tondl and Fornero (2010) that examined the relationship between FDI and productivity in different economic sectors.

1. Liu (2014) shows that agricultural investments can generate a wide range of developmental benefits but these benefits are not expected to arise automatically. The case studies suggest that the disadvantages of large-scale land acquisitions may outweigh the few benefits to the local community according to the local rights and the quality of governance in particular.

There is no study addressing the transmission channels between FDI and food security, especially through agricultural production channel. This paper tries to fill in this gap. Our contribution is at least twofold. First due to different measures of food security and consequently to a number of criticisms like the possible different typology of countries associated with each measure, we propose a composite indicator of food security.² Second, we try to determine the channels by which FDI may affect food security, focusing on the agricultural production. We propose to answer the following questions : Does FDI has a positive impact on food security ? Is agricultural production a pass-through from FDI to food security ? Is this effect observed for all FDI or only FDI in specific sectors ?

To answer these questions we rely on two equations, one for the macroeconomic determinants of food security and the other for the agricultural production determinants. These equations are linked by a simultaneous equation system and tested through three steps least square techniques (3SLS) for an unbalanced panel of 55 developing countries during the period 1995-2009. Our work confirms that the sectoral FDI do not all have the same effects, which supports the argument of Vu and Noy (2009) to use the sectoral FDI rather at its aggregated level.

In this perspective, our work is organized as follows. In the next section, a review of literature is proposed. Section 3 describes the data and the methodology we adopted. The results are then discussed in section 4 and section 5 concludes.

2.2 Review of literature

Agriculture is a pivotal crucial sector for developing countries : it represents an important weight in the developing countries' economy. One of the best ways to prevent food crises in the long-run is to invest in agricultural productivity. Indeed, improving agricultural productivity is an important step towards the growth of food production, the reduction in food prices on local markets and the increase in farm income, which improves the poors' access to food. Productivity is sensitive to the state of health of the population (Timmer, 2010). In fact, hunger affects the health and leads to reduced productivity of people.

2. For more information about the various indices and their limits, see De Haen *et al.* (2011) and Masset (2011).

According to FAO (2006a), this problem hinders economic development and the potential of entire societies. In later publication, the FAO (2009) showed the important role of the agricultural sector in developing countries and especially poor ones. It can be a buffer to the economic and employment during periods of crisis.

Our work is at the crossroads of three fields of the literature, the relationship between FDI and food security, FDI and agricultural production, and food security and agricultural production. From these relations, we seek the two effects of FDI on food security. The first effect is determined by testing the effect of FDI on the food security directly and the indirect effect is determined by spillover of FDI on agricultural production, the latter being important in the improvement of food security. But first of all, we must remind the food security's concept and measurement.

2.2.1 Food security : concept and measurements

Food security is an old concept which was born in the mid-1970s at the world food summit in 1974. In the mid-1980s, food security was defined by the World Bank (1986) as access by all people at all times to enough food for an active, healthy life. This definition has evolved over the years. In 1996, the World Food Summit defined the food security in its declaration by : « *Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life* »(FAO, 2006b).

The FAO identified four dimensions for food security. First, the food availability is « *the availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports* ». Second, the food access is « *the access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet* ». Third, the food use is the « *utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met* ». Finally, the food stability or food secure is « *a population, household, or individual who must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity)* ».

Food security is measured by several indicators related to nutrition and hunger as the per capita per day intake of calories, protein and fat. These indicators allow the follow-up of the food situation of a country. The FAO and the World Health Organization (WHO) measure undernutrition of the individuals by energy requirements in terms of caloric intake, protein intake and fat intake. These requirements constitute the essential nutritive elements in food. Several empirical studies have used the per capita per day calories and protein intake as an indicator of food security like Wimberley (1991), Wimberley and Bello (1992), Firebaugh and Beck (1994), Mihalache-O'Keef and Li (2011) and Djokoto (2012).

The literature also shows several indicators like the ratio of total exports to food imports (Díaz-Bonilla *et al.*, 2000). This indicator is commonly used to measure the macro-level of food security. It enables to know whether a country can achieve food security by generating foreign exchange through exports, which could allow financing food imports. In a descriptive analysis, Breisinger *et al.* (2010) used the inverse of this traditional index to test the vulnerability of the country to secure food import. This indicator is considered by the FAO as an indicator of food stability. Authors have also used other indicators, like food production per capita to assess the agricultural potential, and hunger index to evaluate the famine.

There are also the Millennium Development Goals (MDGs) that present eight goals which the poverty's eradication is one of it (United Nation, 2000). In this context, Gentilini and Webb (2008) proposed a composite indicator labeled the poverty and hunger index. It is a multidimensional index that combines five official indicators of the MDGs : the proportion of population living on less than one US dollar/day, the poverty gap ratio, the share of the poorest quintile in national income or consumption, the prevalence of underweight children (under five years of age) and the proportion of population undernourished.

There are many other indicators of food security discussed in the literature (see DeHaen *et al.* (2011) and Masset (2011)). Some of them are linked to the four pillars of food security and others are from the Millennium Development Goals. This diversity of indicators justifies the complexity of food security's concept. At the empirical level, it is preferable to contain this diversity by the construction of our composite indicator that must be in harmony with

the focus of the paper. This composite indicator, as described below in section 3, relies on four indicators used by the FAO and is based on Principal Component Analysis Techniques.

2.2.2 FDI and food security

In the early 1980s, studies on the relationship between FDI inflows and food security have emerged. The focus was on two contradictory theories : the dependency theory and the modernization theory.

The post-World War II period was characterized by large FDI inflows to DCs, specifically into the extractive sector. In fact, the multinational corporations (MNCs) were on the research of natural resource, cheap labor, and profit. So they penetrated into the most dynamic sectors in DCs, and in consequence, leads the host countries towards improper development (Amirahmadi and Wu, 1994).

Accordingly to this theory, the FDI's effects are potentially destructive, if the MNCs manipulate the prices of goods to avoid taxes, repatriate profit to origin country, influence local politics and economic conditions by controlling the means of production, in addition to adverse effect on growth and the distribution of income (Dixon and Boswell, 1996 ; Heo and Hahm, 2007 ; Adams, 2009). In this regard, the dependency on foreign investment has negative effects on DCs.

Supporters of the modernization theory focus on internal and external sources of economic development. Internal sources come from domestic investment, growth and education by creating industrialization and cultural modernization, and finally provide social welfare (Jenkins and Scanlan, 2001). External sources come from FDIs, which bring technology, organizational capability, management skills and marketing know-how. FDI inflows provide easy access to international markets and diffuse new skills and knowledge in the host economy (Kumar and Pradhan, 2002). The technology transfer and know-how lead to productivity gains and improved efficiency of allocation of resources (Graham, 1995 ; Tambunan, 2005). But the technology transfer has also some adverse effects. On one side, its learning processes is costly. On the other side, the managerial and technical capacities and the ability to finance the adoption of advanced technology are not the same across local firms (Liu, 2008).

The adverse effect is found in Zambia when the presence of foreign firms has reduced the productivity of local firms (Bwalya, 2006).

Both theories have been adopted to explain the impact of foreign investments on welfare. A selected list of papers dealing with the relationship between FDI and food security is provided in Table 2.1.

Theoretically, primary FDI affects food security negatively due to the increase in unemployment, changes in the use of agricultural land, and negative environment and demographic externalities. In contrast, FDI in the secondary sector improve food security by raising employment and wages, technology and knowledge spillovers. However, tertiary FDI has an ambiguous impact partitioned between unskilled and skilled labor. According to Todaro (1969), Evans and Timberlake (1980) and Mihalache-O'Keef and Li (2011), the unskilled labor is affected by tertiary FDI when this latter spurs rural labors to migrate to urban slums for jobs with high incomes, thus subsistence agriculture declines, and therefore migrants pay higher prices on urban markets which reduce their access to food. However, the skilled labor is affected by tertiary FDI flows when the latter improve the individual income, which is favorable to the satisfaction of basic nutritional needs.

To resume, food security may be influenced by FDI. This effect can be explained by the spillover effect of FDI on the source of food : the agricultural production (see Figure 2.1).

FIGURE 2.1 – The relationships between FDI and food security

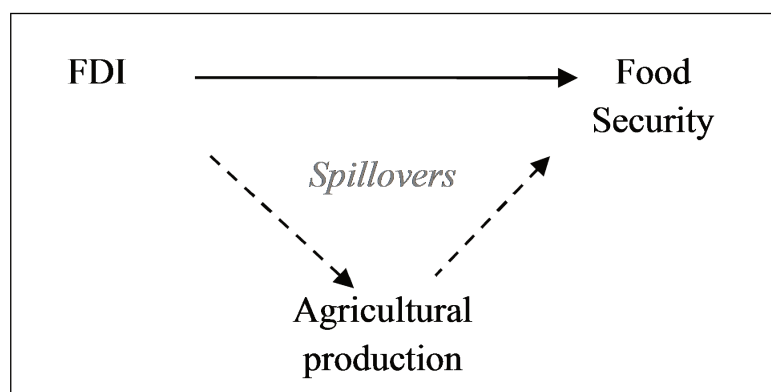


TABLE 2.1 – Selected empirical findings on FDI-food security nexus

Authors	Countries	Methodology	Type of FDI data	Empirical results
	Period			
Wimberley (1991)	60 DCs 1967-1985	Lagged panel	Penetration of transnational corporations	(-)
Wimberley and Bello (1992)	59 DCs 1967-1985	Lagged panel	Penetration of transnational corporations	(-)
Firebaugh and Beck (1994)	62 DCs 1965-1985	- Difference-of-logs model - Difference model	FDI stock as share of GDP	(+) (-)
Jenkins and Scanlan (2001)	88 DCs 1970-1990	Lagged panel	FDI stock over total capital stock ratio	(-)
Mihalache-O'Keef and Li (2011)	56 DCs 1981- 2001	- Lagged panel - Simultaneous equations - Difference model	- Primary FDI ; - Secondary FDI - Tertiary FDI	(-) (+) (+) and (-)
Djokoto (2012)	Ghana	ARDL Model	Agricultural FDI	(-)

2.2.3 FDI and agricultural production

The literature review suggests that the impact of FDI in the agricultural sector can be positive or negative. Some case studies show the FDI's positive side. For instance, in Ghana, the investments by one transnational company contributed to an increase in total production of palm oil and in Uganda, companies such as Tilda (U) Ltd contributed to the growth of rice production, which has almost doubled in the last decade after the introduction of a new variety of rice called Nerica (Gerlach and Liu, 2010). In terms of positive spillovers, the example of Poland is the most appropriate to be cited here, where the vertical and horizontal FDI inflows have positively affected the dairy sector (Dries and Swinnen, 2004). Moreover, spillovers in terms of technology transfers and know-how have improved agriculture production in Ghana (Djokoto, 2012). In fact, the technology transfers can lead to greater domestic productivity, increase in production and employment in addition to a reduction in domestic prices, but this can have both negative and positive environmental effects (Hallam, 2011). In this context, the Uganda's government has adopted friendly production methods to the environment, i.e. investment in floriculture (Gerlach and Liu, 2010). Empirically, the pollution-haven argument can be put forward to explain the potential negative effect of FDI on the environment and households' health. FDI damage the environment, especially when the activity is in the mining industry. For instance, according to Akabzaa and Darimani (2001), the mining industry has weakened and polluted the water table in the Tarkwa mining region in Ghana and this pollution has affected the households' health.

At the sectoral level of FDI, very few works exist on this topic. The sectoral level reveals two directions of the FDI effects. First, the effect is direct from agriculture FDI to agricultural production. Second, the effect is indirect from spillovers of FDI in the rest of economic sectors to agricultural production. This can be seen in the case of Latin America where FDI in agriculture has a positive and significant effect on agricultural productivity and a positive spillover effect from manufacturing FDI and services FDI. The indirect effects may be explained by the presence of foreign capital in agri-food industries, which requires more efficiency in agricultural production. Regarding the spillover effect from FDI in services, the agricultural sector can be beneficial by enhanced productivity in the transport sector (Tondl and Fornero, 2010).

To our best knowledge, there is no study that analyzes the link between sectoral FDI

and the agricultural production. However, the use of food security indicators on explaining the effect of nutrition on farm productivity was tested by Strauss (1986) and Deolalikar (1988). The first used a household-level data from Sierra Leone and he found that nutrient intake has increased the productivity of agricultural labor. Deolalikar (1988) found practically the same results in a sample from the rural south of India. He found that the average daily calorie intake and the weight-for-height lead to improve the agricultural production's growth.

To conclude the literature review, the theory is in favor of a relationship between foreign direct investment and food security, but according to the empirical analysis, there is a lack of evidence on the way FDI may influence food security, in particular at disaggregated level.

2.3 Data and Methodology

2.3.1 Data

This work is based on an unbalanced panel of 55 developing countries (see Table B1 in the Appendix B) over the period 1995-2009. Tables B2 and B3 in the Appendix report the definitions and the descriptive statistics. Most of the data were extracted from the World Development Indicators database of the World Bank. Other data are collected from UNCTAD, FAOSTAT, Polity IV and national sources.

First of all, a correlation analysis is performed between all variables (Table B4 in the Appendix B). We observe that the correlation is low between variables, but it is high between the values of agricultural production, capital stock and labor force in agriculture and the arable land. This high correlation reflects the combination between these variables to achieve the production process.

Different measures of food security were proposed by FAO. The most known one is the per capita per day supply of calories. According to the FAO, this indicator referred to the total amount of food available per day for human consumption divided by the total of population during the reference period. This indicator is used in some empirical works to measure the nutritional status of individuals and to present the food availability, but the literature reveals

that this indicator has several weaknesses due to the low responsiveness to shocks. For example, the decrease of income leads poor people to switch from high value calorie sources to low ones. Consequently, the food expenditure decreases but not the calorie consumption (Jensen and Miller 2010 ; Headey and Ecker 2012). The calorie intake is used in some works like Mihalache-O'Keef and Li (2011). The same authors have used also the protein intake as an indicator to compare results with the calorie intake's results. There is no utility to use these two indicators because the calories are a measure of the energy provided by proteins, fats and some others nutrients³. Otherwise, the calorie intake includes more information about the nutritional status than protein intake. Additionally, the calories alone are not enough to describe the food availability. To deal with the weakness of calories we have chosen the most important indicators from FAOSTAT, which are linked to the agricultural production and food supply. First, we have chosen the average dietary energy supply adequacy as an indicator of adequacy of the food supply in terms of calories. It is calculated as a percentage of the average dietary energy requirement. Second, the average value of food production per capita provides a measure of the economic size of the food production sector and the food availability for everyone in a country. These two indicators describe the first pillar of food security, food availability, and they are calculated on three years averages by FAO to correct errors in the measure. Third, we consider the access to improved water sources, which is the percentage of the population with an access to an adequate amount of water. Finally, the access to improved sanitation facilities is taken into account ; it is expressed by the percentage of the population with at least adequate access to good sanitation. This choice is justified by the fact that people need to utilize food properly to avoid health issues, for example intestinal parasites from unsanitary water (Tweeten, 1999). In addition, the access to water is essential for agriculture and food, and the improved sanitation reduces the pollution caused by human waste. Taken separately, the four indicators mentioned provide a fragmented and sometimes contradictory picture : they tell little about net progress towards reaching the overall goal. A composite index can assemble the information provided by individual measures.

Our analysis will also shed light on the importance of sectoral FDI inflows presented by (i) FDI in agriculture, hunting, forestry and fishing (ii) FDI in mining, quarrying and

3. At the nutritional level, one grams of protein provide four calories; one grams of carbohydrate also provides four calories, and one grams of fats provides nine calories (FAO, 2003).

oil and gas extraction⁴, (iii) FDI in the secondary sector and⁵ (iv) FDI in the tertiary sector in addition to other factors such as economic development, government expenditure, agricultural production, trade openness, political regime.

The economic development is measured by GDP per capita : we expect a positive effect from this variable (Wimberley and Bello, 1992 ; Jenkins and Scanlan, 2001 ; Mihalache-O'Keef and Li, 2011). The government expenditure is measured by the annual growth of the general government final consumption expenditure. This variable is to control the government's role to address food security concerns and a positive impact is expected.

To test for the impact of trade openness, we use the sum of exports and imports of goods and services as a share of GDP. We attend to find a positive impact from trade openness on food security because imports provide the needed complement if the domestic food production is not sufficient (Diaz-Bonilla *et al.*, 2000 ; 2003). In addition, the exports generate foreign exchange revenues used to import food.

The political regime is measured by POLITY2 indicator. This indicator is a modified version of POLITY which varies between 10 (highly democratic) and -10 (very autocratic)⁶. In fact, democratic governments are more likely to provide nutrition to their people than the less democratic or autocratic countries (Sen, 1999 ; Mihalache-O'Keef and Li, 2011). We finally consider the value of agricultural production. The main determinants are capital, labor and land. They are measured respectively by the stock of capital in agriculture, the labor force in agriculture and the area of arable land. We have added the rural population growth as a measure of the population structure to examine if the rural population growth improves the agricultural production. We expect a positive effect on agricultural production as found by Binswanger *et al.*, (1987) that an increase in population density leads to agricultural growth.

4. In this paper, we regress the agricultural production value (not the value added of primary sector). So for a more accurate result, we use the agricultural FDI and mining FDI separately.

5. The estimation's result can be more specific with data for FDI in agri-food industry, but data isn't available for all countries and it has low number of observation so we used the aggregated FDI in secondary sector.

6. See « Polity IV Users' Manual » viewed at : <http://www.systemicpeace.org/inscr/p4manualv2012.pdf>

2.3.2 Methodology

First, we build a composite indicator for food security. Then we specify the equation of macroeconomic determinant of food security and the equation of agricultural production.

Construction of a composite index for food security

In this paper, four indicators of food security are used to build a composite indicator using the principal component analysis (PCA). The indicators are the average dietary energy supply adequacy, the average value of food production per capita, access to improved water sources and access to improved sanitation facilities. The objective of the PCA method is to reduce the number of indicators by the transformation of a set of correlated variables into a new set of uncorrelated variables entitled principal components⁷. The method consists in the capture of the maximum variance between variables, which gives for every principal component a linear transformation as follow :

$$PC^p = \delta_1^p X_1^p + \delta_2^p X_2^p + \dots + \delta_n^p X_n^p \quad (1)$$

With, PC^p is the P th principal component. X_n^p is the value of the n th variable for the P th component and δ_n^p is the regression coefficient for the n th variable of the P th component and it is the eigenvector of the covariance matrix between the variables.

TABLE 2.2 – Correlation test between the food security indicators

	(1)	(2)	(3)	(4)
(1) average dietary energy supply adequacy	1			
(2) average value of food production per capita	0.4373	1		
(3) access to improved water sources	0.6071	0.4701	1	
(4) access to improved sanitation facilities	0.5873	0.5169	0.8673	1

Source : authors' calculations.

Return to our data, there is a high correlation between our four indicators (see Table 2.2), so the PCA method can be used here. The literature of PCA method reveals many extensions to this method. One of the extensions is the correction of outlying in the data. We believe that the four indicators are different between DCs and to avoid this problem we followed the methodology of Verardi (2009) to do a robust analysis of the principal component.

7. The use of PCA technic in food security indicators was suggested by Conforti (2013) from FAO STATISTIC DIVISION at the 23rd African Commission on Agricultural Statistics in Morocco.

TABLE 2.3 – Total variance of principal components

Component	Eigenvalue	Proportion of information	Cumulative of information
PC1	2.61424	65.36	65.36
PC2	0.748148	18.70	84.06
PC3	0.537943	13.45	97.51
PC4	0.0996734	2.49	100

Source : authors' calculations.

Note : the two columns Proportion of information and Cumulative of information are in percentage (%).

The number of principal components is chosen based on two criteria. It is chosen according to (1) the cumulative variance of which at least 60 to 70 percent of the total information is explained and (2) the Kaiser criterion (Kaiser, 1960) which is used to keep the principal components that have an eigenvalue more than one.

The results in Table 2.3 show that the choice of the first component (PC1) is most appropriate because 65% of the total information is accounted by it. In addition, its eigenvalue is greater than one.

TABLE 2.4 – The eigenvectors of each component

	PC1	PC2	PC3	PC3
average dietary energy supply adequacy	0.3766	0.9037	-0.1968	-0.0524
average value of food production per capita	0.4983	-0.0130	0.8532	0.1536
access to improved water sources	0.5453	-0.2853	-0.4405	0.6535
access to improved sanitation facilities	0.5589	-0.3190	-0.1982	-0.7393

Source : authors' calculations.

Since we have choose the first component, then we choose the first eigenvector from Table 2.4. For a given year, multiplying each indicator by the square of the coefficient of the first eigenvector that corresponds to it, leads to a score. In turn, this score is our composite indicator and can be decomposed as follow :

$$\begin{aligned} \text{FSI} &= 0.137 \times \text{average dietary energy supply adequacy} \\ &+ 0.229 \times \text{average value of food production per capita} \end{aligned}$$

$$\begin{aligned}
& + 0.303 \times \text{access to improved water sources} \\
& + 0.331 \times \text{access to improved sanitation facilities}
\end{aligned}$$

Estimated model

We estimated two equations. However, the specific effect on the estimation can be fixed or random. To avoid this problem, we used the specification of Hausman (1978). The Hausman test's null hypothesis is that the preferred model is random effects and the alternative is fixed effects, and the result suggested the fixed effects model. To find a way around the heteroscedasticity and autocorrelation, we follow Mihalache-O'Keef and Li (2011) and we use Huber-White robust standard error, clustered over countries.

As an initial step, we test the relationship between sectoral FDI and food security (equation 2). We estimate a fixed effect model as follow :

$$\begin{aligned}
FSI_{it} = & \alpha_0 + \alpha_1 FDI_agri_{it} + \alpha_2 FDI_minig_{it} + \alpha_3 FDI_secondary_{it} \\
& + \alpha_4 FDI_tertiary_{it} + \alpha_5 \ln_prodagr_{it} + \alpha_6 Openness_{it} \\
& + \alpha_7 \ln_GDP_percapita_{it} + \alpha_8 Gov_exp_{it} + \alpha_9 polity2_{it} \\
& + \gamma_i FE_i + \delta_t FE_t + \varepsilon_{it} \quad (2)
\end{aligned}$$

Where i and t refer to countries and years, respectively; α_k are the estimated coefficients and ε_{it} is the error term. FDI_agri , FDI_mining , $FDI_secondary$, $FDI_tertiary$ represent agricultural, mining, secondary and tertiary foreign direct investments respectively, $\ln_prodagr$ is the logarithm of agricultural production value, $Openness$ is the trade openness, $\ln_GDP_percapita$ is the logarithm of GDP per capita, Gov_exp is the annual percentage growth of general government final consumption expenditure and $Polity2$ is the political regime. FE_i are the country fixed effects and FE_t represent time fixed effects.

In a second step, we consider the determinant of the agricultural production as a fixed effect model. Empirically, the agricultural production is widely treated by the estimation of Cobb-Douglas production function or a translog production function. Nevertheless, the purpose of our analysis has no interest to the partial elasticities of inputs variables or the exam of the inputs substitution, so a simple agricultural production can be used in our case.

Further, the Cobb-Douglas agricultural production function (Cobb and Douglas, 1928) is largely used in the economic literature without a theoretical framework. Some authors have added other factors to explain the agricultural production. e.g. to investigate the effects of infrastructure, investments in agricultural research and education (Antle, 1983), to test the effects of transportation infrastructure and electricity on the agricultural production (Felloni *et al.*, 2001), to examine the effect of governance quality (Lio and Liu, 2008) and to check the impact of climatic change on the agricultural production (Barrios *et al.*, 2008).

The equation of the agricultural production is given by :

$$\begin{aligned} \ln_prodagr_{it} = & \beta_0 + \beta_1 \ln_K_{it} + \beta_2 \ln_L_{it} + \beta_3 \ln_land_{it} + \beta_4 FDI_agri_{it} \\ & + \beta_5 FDI_mining_{it} + \beta_6 FDI_secondary_{it} + \beta_7 FDI_tertiary_{it} + \beta_8 FSI_{it} \\ & + \beta_9 Rural_pop_{it} + \gamma_i FE_i + \delta_t FE_t + \theta_{it} \end{aligned} \quad (3)$$

Where β_i are the estimated coefficients and θ_{it} is the error term. \ln_K , \ln_L and \ln_land are the main inputs of the agricultural production and they represent the capital stock, labor force in agriculture and arable land respectively. FSI and $Rural_pop$ are our food security index and the rural population growth respectively. As shown in the equation, we test for the impact of the sectoral FDI on the agricultural production. We integrate the composite indicator as a measure of individual energy intake and food availability because the lack of a person's energy nutrition with access to food, water and good sanitation reduces its ability to produce, which means that more workers are malnourished, less labor productivity is provided for agricultural production.

In a third step, we determine whether there is a relationship among variables between equations (2) and (3). Therefore, we tested for the endogeneity between the food security composite indicator and the agricultural production with the Durbin-Wu-Hausman endogeneity test⁸. The results suggest that endogeneity is significant. Thus, we estimated a simultaneous equations model with fixed effects (by year and by country) by using the three-least squares (3SLS) method. The use of 3SLS method is validated by the Breusch-Pagan Lagrange Multiplier Diagonal Covariance Matrix Test under the null hypothesis that ordinary least

8. The test is explained by Li and Liu (2005) where they test the endogeneity between FDI and economic growth.

square (OLS) method is consistent⁹.

2.4 Estimation results

2.4.1 Estimation results of equations

Table 2.5 provides estimation results of equation (1). In columns (1)-(4), we added GDP per capita, trade openness, government expenditure and political regime separately. Column (5) present the estimation's results of equation (1). The coefficient of determination (R2) is high in all equations and it slightly exceeds the 80%. We have included the country and year fixed effects on all regressions.

TABLE 2.5 – Estimation results of food security equation

	(1)	(2)	(3)	(4)	(5)
Ln_prodagr	1.083*** (8.79)	1.156*** (8.48)	1.160*** (8.18)	1.185*** (8.43)	1.100*** (8.52)
FDI_agr	0.085* (1.76)	0.110** (2.08)	0.113** (1.97)	0.109** (2.07)	0.079 (1.59)
FDI_min	-0.012 (-1.32)	-0.017* (-1.74)	-0.014 (-1.47)	-0.017* (-1.84)	-0.012 (-1.27)
FDI_secondary	0.001 (0.09)	-0.002 (-0.14)	-0.001 (-0.03)	-0.003 (-0.19)	0.002 (0.12)
FDI_tertiaryper	-0.015*** (-2.88)	-0.009* (-1.77)	-0.009* (-1.76)	-0.010* (-1.95)	-0.016*** (-2.94)
Ln_GDP_percapita	0.587*** (2.67)				0.561*** (2.65)
Openness		0.001 (0.44)			0.000 (0.29)
Gov_exp			0.002 (1.14)		0.002 (1.21)
Polity2				0.010* (1.81)	0.009** (2.07)
Year and country fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.817	0.804	0.809	0.806	0.823
Ajusted R-squared	0.778	0.762	0.770	0.765	0.785
Number of observations	419	417	390	412	390
Number of countries	53	53	52	46	46

Note : The dependent variable is the composite indicator (FSI). Column (5) reports the estimation of equation (1). t-statistics are in parentheses. Significance at the 1, 5 and 10 percent levels are denoted respectively by ***, **, *. The constant is not reported.

9. We perform this test by the Stata command of Shehata (2012).

In column (1), we found, as expected, a positive and significant effect of agricultural production on food security. For sectoral FDI variables, only two variables have a significant effect. FDI in agricultural sector has a positive and significant effect at level of 10%, and FDI in tertiary sector has a negative and significant effect at level of 1%. GDP per capita also shows a positive effect and significant at level of 1%. In column (2), we replaced GDP per capita by trade openness. The result shows no significant effect from trade openness but the coefficient of FDI in mining sector became significant at level of 10% with negative sign. In column (3), we have replaced trade openness by government expenditure and the estimation reports the same result as previous estimations. We consider in column (4) the political regime and we found a positive and significant coefficient for this variable. Finally, in column (5), we take into account all variables. Results confirms that the agricultural production, economic development and political regime are a good determinant of food security, but FDI in tertiary sector is harmful.

Table 2.6 displays the estimation results of agricultural production equation. Before we estimate all variables, we examined in column (1) the correlation between sectoral FDI and agricultural production. We found that FDI in agriculture and secondary sectors affects positively the agricultural production. FDI in tertiary sector seem to be have a negative and significant effect. FDI in mining has a negative sign but not significant. By adding the food security indicator in column (2), the coefficient of FDI in agricultural sector became no significant.

In column (3), we added the capital stock, labor force and arable land. The significant effect of FDI in tertiary sector disappeared and effects of secondary FDI and FSI remain positive and significant. For input variables, only capital stock and labor force are positive and significant. After the inclusion of rural population growth in column (4), only secondary FDI, FSI, labor force and rural population growth are significant.

2.4.2 Estimation results of the simultaneous equations models

Table 2.7 reports the estimated results of simultaneous equations using 3SLS. First, we estimate the system three times. In Model 1, GDP per capita, government consumption and political regime are dropped from the food security's equation, and rural population growth

TABLE 2.6 – Estimation results of agricultural production equation

	(1)	(2)	(3)	(4)
FDI_agr	0.049** (2.05)	0.011 (0.74)	0.013 (0.71)	0.009 (0.50)
FDI_min	-0.002 (-0.70)	0.002 (0.62)	0.001 (0.12)	0.001 (0.17)
FDI_secondary	0.013* (1.93)	0.010* (1.79)	0.022*** (3.88)	0.021*** (3.81)
FDI_tertiary	-0.012*** (-3.89)	-0.007** (-2.55)	-0.005 (-1.60)	-0.005 (-1.61)
FSI		0.217*** (8.88)	0.160*** (4.84)	0.168*** (5.05)
Ln_K			0.205* (1.91)	0.179 (1.63)
Ln_L			0.416*** (6.13)	0.435*** (5.94)
Ln_land			0.058 (1.00)	0.045 (0.74)
Rural_pop				0.025* (1.95)
Year and country fixed effects	Yes	Yes	Yes	Yes
R-squared	0.605	0.730	0.747	0.753
Ajusted R-squared	0.527	0.674	0.682	0.688
Number of observations	440	419	351	351
Number of Countries	55	53	52	52

Notes : The dependent variable is the value of agricultural production (Ln_prodagr). Column (4) reports the estimation of equation (2). t-statistics are in parentheses. Significance at the 1, 5 and 10 percent levels are denoted respectively by ***, **, *. The constant is not reported.

is dropped from the production equation. In Model 2, we added the GDP per capita and finally in model 3 we include the rest of variables. All models contain time and country fixed effects.

Our first finding is that our composite indicator and agricultural production have positive and significant coefficients. Beginning by Model 1, we found the composite food security indicator and labor force in agricultural sector have positive and significant coefficients. However, only the FDI in secondary sector affects agricultural production with a positive and significant coefficient. This means that there is a spillover effect from manufacturing FDI on agricultural production, and therefore on food security. In the food security equation, only tertiary FDI and trade openness are not significant. FDI in agricultural and agricultural production affect positively the food security, however, FDI in mining and in secondary sectors have a negative impact significant at the level of 10%.

After the addition of GDP per capita in Model 2, the trade openness becomes significant with the expected positive sign. FDI in tertiary sector also becomes significant but with negative sign. FDI in mining is no more a statistically significant factor. In the agricultural production's equation, the negative sign of FDI in tertiary sector and the positive signs of capital and arable land become significant.

Finally, in Model 3 we added the rest of variables and we have found that government expenditure is an important determinant to explain the improvement of food security and the rural population growth to explain the increase on agricultural production. Other variables have the expected signs. Finally, the coefficient associated to the political regime is positive but not significant.

In terms of growth, we interpret the increase of one independent variable while all other variable in the model are held constant. A 1% increase in the share of secondary FDI to GDP leads to 1.74% increase in agricultural production, while 1% in tertiary FDI declines the agricultural production about 0.4%. A unit increase in food security indicator is associated with an average of 22% increase in agricultural production. At the same time, a 1% increase in the agricultural production and agricultural FDI, respectively, is associated with 0.155 and 0.012 units increase in the food security's composite indicator. However, an

TABLE 2.7 – Estimation results of simultaneous equations

	Model 1		Model 2		Model 3	
	FSI	Ln_prodagr	FSI	Ln_prodagr	FSI	Ln_prodagr
FDI_agr	0.156*** (3.41)	-0.0438 (-0.867)	0.123*** (2.75)	0.0141 (0.53)	0.155*** (3.24)	-0.00732 (-0.25)
FDI_min	-0.0199* (-1.68)	0.00712 (0.958)	-0.0148 (-1.28)	0.00164 (0.293)	-0.00865 (-0.738)	0.000341 (.0613)
FDI_secondary	-0.0221* (-1.94)	0.0186*** (3.05)	-0.0221** (-1.99)	0.0202*** (3.94)	-0.0216* (-1.89)	0.0174*** (3.25)
FDI_tertiary	-0.0054 (-1.1)	-0.00128 (-.378)	-0.00845* (-1.75)	-0.00459** (-2.12)	-0.0101** (-2.09)	-0.00389* (-1.82)
Ln_prodagr	1.29*** (7.28)		1.35*** (7.89)		1.2*** (6.68)	
Openness	0.00136 (1.46)		0.00147** (2.09)		0.0018** (2.49)	
Ln_GDP_percapita			0.535*** (5.04)		0.46*** (4.57)	
Gov_exp_					0.00165** (2.19)	
Polity2					0.000544 (0.162)	
FSI		0.424** (2.42)		0.181*** (2.63)		0.226*** (3.36)
Ln_K		0.191 (.964)		0.357*** (3.66)		0.293*** (3.04)
Ln_L		0.155*** (3.42)		0.256*** (5.68)		0.277*** (6.12)
Ln_Land		0.0809 (1.01)		0.133*** (2.93)		0.121*** (2.66)
Rural_pop						0.0117* (1.75)
Constant	-7.42*** (-3.09)	5.53*** (4.83)	-12*** (-5.02)	5.24*** (7.02)	-9.36*** (-3.79)	5.34*** (7.23)
Number of observations		353		353		332
Number of Countries		55		55		51
Overall R2		0.8509		0.8512		0.7634
Overall R-adjusted		0.8106		0.8106		0.6965
Lagrange Multiplier Test		169.08683***		284.52870***		159.06136***

Note : t-statistics in parentheses. ***, **, * Significant at the 1%, 5% and 10% respectively.

increase of 1% in secondary and tertiary FDI is followed by a decrease about 0.022 and 0.01 units, respectively.

In sum, our results give importance to agricultural FDI, agricultural production, trade openness and economic development in improving food availability and food utilization. In addition, our results highlight the adverse effects of FDI in secondary and tertiary sectors. These effects are lower comparing to the positive one from FDI in agriculture. This negative impact is a result of industrial development's pollution that affects environment and access to water, and thus the food availability and utilization. However, the positive effect from secondary FDI provides employment and spillover effect in term of technology transfer and know-how that are useful in improving agricultural production, the access to water and improved sanitation.

2.5 Conclusion

In recent decades, food security has taken more attention from policy makers in the developing world and FDI inflows became one of the main factors of development and growth in these countries. FDI inflows are expected to have some effects in DCs, specifically in food security context.

The sectoral FDI inflows' effects can shed new light on how the transmission takes place. In this paper, we treat the macroeconomic dimension of food security by the use of an unbalanced panel data of 55 developing countries for the period 1995-2009. The review of literature shows that the relation between FDI and food security is being discussed empirically as a direct relationship with the neglect of agriculture's role. Our work proposes an extension : we take into account the indirect effect through the agricultural production.

As shown in this paper, empirical research on the contribution of FDI in improving food security remains ambiguous and needs more work on it. Following a number of studies showing that FDI inflows affect food security, we found that the direct effects come from FDI in agriculture and the indirect effects come from FDI spillovers in the other economic sectors. Our results have confirmed that FDI improves directly food availability and utilization by

increasing food supplies, and access to water and improved sanitation. Food availability has a direct link with the agricultural production. If the DCs increase their agricultural production, the calorie supply and food production rise. This is an important step to decrease food prices. In addition, when the agricultural production increases, sellers will expand their radius of sale, which may be beneficial for people in less favorable areas of the nation.

Agricultural FDI contributes to the improvement of food security thanks to the increase in agricultural production, which is the main source of food. The benefits for agriculture due to agricultural FDI are in terms of know-how, Research and Development (R&D) and technology transfer. The secondary FDI creates employment, increases the individual's income, and therefore improves access to food. In contrast, negative spillovers from tertiary FDI on agricultural production and food security could be explained by the argument that FDI creates jobs in urban areas with higher wages which encourages workers in rural areas to migrate. Thus, on the one hand, the increase in demand in urban areas will increase the price paid by migrants and therefore reduces their access to food (Todaro, 1969 ; Evans and Timberlake, 1980 ; Mihalache-O'Keef and Li, 2011), on the other the labor force in agriculture will decrease which could reduce the agricultural production. Another negative effect from secondary on food availability and utilization can be explained by the pollution produced during manufacturing process.

Our findings have important implications. They give importance to FDI in increasing agricultural production and thus improving food security. However, we should not neglect that the host country must have the ability to absorb technology transfer and know-how. The discussion of the appropriate local policies needed for improving food security has to be deepened.

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Annex B

TABLE B.1 – List of countries

1	Albania	12	Colombia	23	India	34	Mauritius	45	Russian Federation
2	Argentina	13	Costa Rica	24	Indonesia	35	Mexico	46	Saudi Arabia
3	Armenia	14	Croatia	25	Kazakhstan	36	Moldova	47	Thailand
4	Bangladesh	15	Ecuador	26	Kyrgyz Republic	37	Morocco	48	Tunisia
5	Bolivia	16	Egypt	27	Lao PDR	38	Mozambique	49	Turkey
6	Bosnie-Herzégovine	17	El Salvador	28	Latvia	39	Nicaragua	50	Ukraine
7	Brazil	18	Ethiopia	29	Lithuania	40	Pakistan	51	Tanzania
8	Bulgaria	19	Fiji	30	Macedonia	41	Panama	52	Uruguay
9	Cambodia	20	Guyana	31	Madagascar	42	Paraguay	53	Vanuatu
10	Chile	21	Honduras	32	Malawi	43	Peru	54	Zambia
11	China	22	Hungary	33	Malaysia	44	Philippines	55	Romania

TABLE B.2 – Definitions of variables

Variable	Definition	Source
average dietary energy supply adequacy	the dietary energy supply as a percentage of the average dietary energy requirement in each country	
average value of food production per capita	The total value of annual food production, in International Dollars divided by the total population	FAOSTAT
access to improved water sources	The percentage of the population with access to an improved water source	
access to improved sanitation facilities	the percentage of the population with access to improved sanitation facilities	
FSI	The composite indicator of food security	Authors' calculation
FDI_agri	Agriculture, hunting, forestry and fishing FDI inflows as share of GDP (%)	
FDI_mining	Mining, quarrying, oil and gas FDI inflows as share of GDP (%)	
FDI_secondary	Secondary FDI inflows as share of GDP (%)	National source and UNCTAD
FDI_tertiary	Tertiary FDI inflows as share of GDP (%)	
Openness	The sum of exports and imports of goods and services as a share of GDP	World development indicator (WDI)
Ln_GDP_percapita	The logarithm GDP per capita million at constant 2000 prices	WDI
Gov_exp	The annual growth of the general government final consumption expenditure	WDI
polity2	Political regime	Polity IV
Ln_prodagr	The logarithm of agricultural production, measured by the value of agricultural production in millions of dollars at constant 2005 prices	FAOSTAT
Ln_K	The logarithm of capital stock in agriculture millions at constant 2005 price	FAOSTAT
Ln_L	The logarithm of labor force in agriculture in thousand people	UNCTAD
Ln_land	The Logarithm of arable land in hectares	WDI
Rural_pop	The annual growth of the rural population	WDI

TABLE B.3 – Summary statistics

Variables	Observation	Mean	Std. Dev.	Min	Max
average dietary energy supply adequacy	930	114.97	14.20	72	163
average value of food production per capita	930	275.63	156.80	44	1006
access to improved water sources	914	84.52	16.22	20	100
access to improved sanitation facilities	920	69.48	26.29	3	100
FSI	892	9.85	2.03	3.15	14.41
FDI_agri	492	0.11	0.34	-.64	2.84
FDI_mining	445	0.54	1.31	-1.55	15.94
FDI_secondary	675	0.85	0.98	-1.78	11.48
FDI_tertiary	688	2.08	2.75	-2.12	32.17
Ln_prodagr	945	15.08	1.80	9.42	20.07
Openness	937	80.79	36.92	14.93	220.40
Ln_GDP_percapita	937	7.36	1.08	4.73	9.87
Gov_exp	850	4.48	9.89	-57.81	83.22
polity2	900	4.53	5.71	-10	10
Ln_K	819	9.33	1.78	3.67	13.23
Ln_L	945	7.14	2.21	0	13.13
Ln_land	945	14.72	2.02	7.60	18.90
rural_pop	945	0.36	1.24	-4.42	3.48

TABLE B.4 – Correlation test

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) FSI	1.0000												
(2) FDI_agri	-0.0285	1.0000											
(3) FDI_mining	-0.0884	-0.0486	1.0000										
(4) FDI_secondary	0.0193	0.1570	-0.1177	1.0000									
(5) FDI_tertiary	0.1484	0.0437	0.0297	0.3328	1.0000								
(6) Ln_prodagr	0.0915	-0.1994	-0.0502	0.0279	-0.2568	1.0000							
(7) Openness	0.2488	0.1706	-0.1537	0.3110	0.2641	-0.4075	1.0000						
(8) Ln_GDP_percapita	0.8583	-0.0364	-0.0858	0.0130	0.1426	0.0431	0.1481	1.0000					
(9) Gov_exp	-0.1765	0.1274	-0.0636	0.1602	0.0341	0.0757	-0.0051	-0.1925	1.0000				
(10) polity2	0.2577	0.1053	-0.0635	-0.0219	0.1648	-0.2514	0.1720	0.3088	-0.1578	1.0000			
(11) Ln_K	0.0248	-0.1737	0.0412	-0.0886	-0.2566	0.9357	-0.5372	-0.0095	0.0829	-0.2786	1.0000		
(12) Ln_L	-0.4190	-0.1213	0.0017	-0.0128	-0.2902	0.6744	-0.5208	-0.4237	0.1344	-0.4072	0.6755	1.0000	
(13) Ln_land	-0.1076	-0.1937	-0.0060	0.0033	-0.1924	0.8647	-0.3721	-0.1518	0.0898	-0.3467	0.8771	0.6391	1.0000
(14) rural_pop	-0.6391	0.0411	0.0653	-0.0630	-0.2492	-0.1925	-0.0944	-0.5829	0.1014	-0.1649	-0.1513	0.1663	-0.0902

Chapitre 3

FDI AND FOOD SECURITY IN DEVELOPING COUNTRIES : INSTITUTIONAL QUALITY MATTERS

3.1 Introduction

The World Economic Forum 2015 has identified food security as one of the ten global challenges that require collaboration across different sectors (Parker, 2015). This challenge concerned all countries, in particular developing ones (DCs). These countries are vulnerable to food insecurity. The achievement of food security is a crucial objective, which needs many factors to interact. At the same time, to boost economic growth, DCs compete to attract foreign direct investment (FDI). In addition to their impact on employment, these investment flows are important since they represent a funding source and create spillovers, in other words, these countries expect a lot from the economic growth. Growth, which is due to the increase in national production, needs in reality an increase of production factors. Economic literature often uses the variation in per capita income to measure growth or rather the economic performance (Acemoglu *et al.*, 2001 ; Rodrik *et al.*, 2004). Nevertheless, DCs are confronted by the inequality of income distribution. Actually, dividing national production by the population doesn't indicate that the entire population is benefiting from the increase in national wealth, so it does not necessarily reflect the improvement of life quality in the

society. The distribution of income is a crucial factor that influences food security (Timmer, 2000). To control this issue, the economic literature often uses the Gini index to measure the bad distribution of wealth in a country.

Following the same reasoning, FDI inflows may increase the economic performance through technology and knowledge transfer, and spillovers. The economic performance, with good governance within local institutions, generates externalities by making food accessible with improved consumption conditions. On one side, the institutional quality plays an important role in this process because it has the role of adjudicator to shape the economy and to guaranty that people benefit from the prosperity of their nation. The institution “*shapes*” the economic behavior by influencing the investment in physical and human capital and technology, and the organization of production (North, 1990 ; Acemoğlu *et al.*, 2005). On the other side, the institutional quality is like the showcase of a country. It is a factor of attractiveness and an important actor to exploit efficiently FDI (Anwar and Cooray, 2015).

According to the economic literature, several authors like North (1990), Acemoğlu *et al.* (2001, 2005) and Rodrik *et al.* (2004) have emphasized the endogenous role of the institutional quality on the economic performance. However, the impact of FDI on economic performance and welfare, in general, is still ambiguous. Most of research papers have used aggregated data of FDI inflows and few papers use disaggregated level. Moreover, the study of FDI effects has become a transdisciplinary question. Sociologists have largely discussed this topic on food security context (Wimberley, 1991 ; Firebaugh, 1992 ; Firebaugh and Beck, 1994 ; Jenkins and Scanlan, 2001 ; Mihalache-O’Keef and Li, 2011). Economists were more interested in the effects of FDI on economic growth and firms’ productivity (Findlay, 1978 ; Wang, 1990, 2009 ; Wang and Blomstrom, 1992 ; de Mello, 1999 ; Lipsey and Sjöholm, 2004 ; Cieřlik and Tarsalewska, 2011). Ben Slimane *et al.* (2016) have focused on the role of agricultural production in addition to the sectoral FDI inflows in improving food security. Their findings argue that agricultural production is a vital factor of food security and it is a channel of FDI’s spillovers effects.

Starting from the idea that achieving food security is the government’s responsibility, we attempt to re-examine the role of sectoral FDI in improving food security by considering the institutional quality of DCs. These effects are analyzed through the improvement of

income, which makes the economic access to food easier. An important gap in the empirical literature concerns the interrelation between the macroeconomic environment and food security. The existing empirical literature has focused on three main economic aggregates : institutions, FDI inflows and economic performance. The purpose is often a review of the institutional quality and FDI inflows' effects on economic growth. The food security is seldom examined in this context. We formulated our motivation in few questions. Do FDI inflows influence the economic performance? Then does the improvement of income impact food security? What is the role of domestic institutions in this process? Finally, does the income inequality matter? To answer these questions, firstly, we extended the food security measure of Ben Slimane *et al.* (2015) by adding a second indicator with principal component analysis (PCA). The second one is calculated from three indicators : the share of dietary energy supply derived from cereals, roots and tubers, and prevalence of anaemia among pregnant women and children under 5 years of age. We consider, secondly, that FDI influence the economic performance by increasing income per capita. This effect is explained in part by the presence of good institutional quality, which is important to shape the economy and to absorb the positive spillovers of FDI. Thirdly, economic performance leads to improve food security by increasing the income and providing the necessary environment to facilitate access to available food. We believe that using disaggregated data for FDI can give us a clearer picture in the nature of the interaction between FDI and the institution's quality to go towards influencing income and food security, so we use the sectoral level of FDI on primary, secondary and tertiary sectors. Finally, we use the Gini index of Solt (2014) to control the inequality of income distribution.

The remainder of the paper is organized as follows. Section 2 presents the theoretical background. Section 3 describes the econometric methodology and the data used in this study. The empirical results are reported in section 4 and section 5 concludes.

3.2 Literature review

The economic literature relies on a number of models to explain the economic performance. The exogenous growth models (Solow, 1956 ; Cass, 1965 ; Koopmans, 1965) followed by the first wave of endogenous growth model as Romer (1986) and Lucas (1988), where they take into account the spillover effects from investing in physical and human capital. Then, the

industrial innovation is considered as the engine of growth (Romer, 1990 ; Aghion and Howitt, 1992). The capital accumulation is always considered as an important economic process to explain the economic performance. Previous economic research concretely showed that FDI influence economic performance through capital accumulation and knowledge transfers (de Mello, 1999). The contribution of FDI is due to externalities and spillovers ; in this context, several modeling attempts have been made to exploit the channel through which FDI affect growth and to examine if FDI can be a channel of spillovers (Findlay, 1978 ; Wang, 1990 ; Wang and Blomström, 1992). According to Acemoğlu *et al.* (2005), these traditional growth models “*only provide proximate explanations of comparative growth*”, and for this reason these authors have considered that economic institution “*shapes*” the economic incentives, and thus influences economic outcome (Acemoğlu *et al.*, 2001 ; 2005). Consistent with North and Thomas (1973), they consider that institutions are the “*deep*” of economic performance. Hausmann and Rodrik (2003) argue that economic growth requires foreign technology and good institutions, and that is why poor countries may grow better if they reached some highest scientific level with respect of property rights.

In sum, the economic literature shows several proofs that FDI and the institutional quality influence the economic performance but there is a lack in the empirical literature when the discussion extend to food security. Hence, we examine food security state of DCs in presence of foreign capital and institution.

3.2.1 Domestic institutions' effects on the host economy

At the globalization's era, the economic literature on the institutions' topic is rather abundant. Institutions take the role of a regulator of individual's relationships. North (1990) has involved the importance of humans' role in the institution concept. He gives the most known institution's definition. He said, “*Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction. In consequence, they structure incentives in human exchange, whether political, social, or economic...*”. Indeed, the type of institution is very important to distinguish its impact on the economic performance. It can be inclusive or extractive. The inclusive one is characterized by enhancing economic growth and prosperity because this type of institution is in favor of property rights protection to encourage the investment, to use better resources and

technologies, to make a way to innovation, and it provides some degrees of equality in the society. In contrast, the extractive institution is harmful for prosperity because it may give the most power to narrow elite for governing the rest of society. This minority will make the institutional structure and the distribution of wealth in its favor, which discourages the rest of society to be creative and innovative (Acemoglu *et al.*, 2001, 2005; Acemoglu and Robinson, 2011).

Moreover, the literature shows proofs that economic institution is strongly linked to capital market, this latter has a central role for investment. The imperfection of capital market hinders growth and investment in both the short and the long run (Galor and Zeira, 1993). Acemoglu *et al.* (2005) argue that economic institution is the pillar of economy and prosperity, and they pointed out that the difference of prosperity across societies is that humans create their advantages by organizing their societies in a way to providing some degree of opportunity (for example, the institution ensures the equality before the law and the investment opportunity). To this end, conflicts will arise between the different groups and individuals in society and will come to in favor of who has the most political power. Here comes the central role of political institutions to absorb the conflict by facing inequalities. The political institutions' role has been examined in the work of Alesina and Rodrik (1994). Authors have proposed an endogenous growth model with distributive conflicts of how the political regime, distribution of wealth and growth are connected. Their model suggests that democracies with an uneven distribution of wealth leads to lower growth than democracies with more equally distributed resources. The recent literature has examined the association between the distribution of income and FDI. For example, Choi (2006) found that FDI lead to more income inequality by using data from 1993 to 2002. In contrast, Sylwester (2005) fails to find a strong association between the two variables. We explain these two opposite findings by the fact that FDI inflows exploded in the early 90s, while the Sylwester' study focuses in the period between 1970 and 1989.

The literature also shows the link between the institutional quality and FDI. Indeed, investors are obliged to cooperate with local institutions. Reducing the difficulties, caused by the bureaucracy and secure property rights, leads to an efficient allocation of resources of these investors (Stern, 1991). Olofsdotter (1998) has confirmed this intuition when he found that FDI have a stronger positive effect on growth in presence of good bureaucratic efficiency.

The institutional quality is considered by the foreign investors as the main criteria to relocate. FDI are attracted by the stability of the host government (Mina, 2012). The role of the host countries institutions aims at protecting the property rights, the enforcement of contracts and facilitating collective action (Dixit, 2009). In order to enhance the income level, DCs must provide a suitable institutional and economic environment for foreign capital. Despite the importance given to institutions, the gap between countries in terms of institution's quality remains important. Institutions are considered as a source of comparative advantage (Nunn and Trefler, 2014). A number of studies showed that countries with good institutions present an attractive investment destination (Hall and Jones, 1999 ; Paarlberg, 2002 ; Anghel, 2005 ; Mina, 2012).

The institutional quality of the host country is an important determinant for attracting FDI. As shown by Bénassy-Quéré *et al.* (2007), the quality of institutions matters for FDI inflows. A stable political and economic climate, protection of property right, lack of corruption, and fast and flexible bureaucratic procedure are very important in the decision of foreign investors to relocate. Some other factors can influence the absorptive capacity of FDI as the degree of openness to trade and the size of domestic market. However, the inflation presents a constraint to FDI because it harms the macroeconomic performance (de Mello, 1997, 1999 ; Bénassy-Quéré *et al.*, 2007).

Several domestic factors can explain the relocation of multinational corporations (MNCs) in developing countries. For example, Botswana has received the highest rates of FDI per capita in Sub-Saharan Africa thanks to its low political risk (Coolidge and Rose-Ackerman, 2001). Countries that have a bad government and/or do not respect the private contracts and/or neglect the transport and communication infrastructures are the less attractive for foreign investors. These indicators have an impact on the investment decision of the new MNCs and of the MNCs already in place. For instance, the lack of peace, property protection, and contract enforcement in Africa reduced investment (Paarlberg, 2002). The robustness of institutions is the main criteria considered by investors. The institutional quality is the main determinant for foreign investors to make relocation's decision. Investors are relocating their business to markets where they are able to apply their activities efficiently (WTO, 1996). A good institution encourages the accumulation of skills, the development

of new goods and production techniques, and reassures investors. An economic policy that protects the investors and enhances government stability can promote FDI inflows (Mina, 2012). A good institution allows to reduce transactions costs and investor risks, which are important for the investment climate (Hallam, 2011). By contrast, a low institution quality encourages rent seeking, corruption, and theft (Hall and Jones, 1999). The role of governments is crucial to earn greater profits from FDI inflows. Low government's efficiency reduces the attractiveness of foreign investors (Anghel, 2005). In this respect, many African countries have worked in this direction. They have provided a stable investment environment, by creating investment promotion institutions. Agricultural development is a crucial factor for food security and institutions can support it, for example, by the creation of R&D centers to improve agricultural productivity, providing infrastructure facilities and improving water management (UNCTAD, 2009).

As for the link between institutions, trade and growth, the empirical literature shows that higher institution's quality is a factor of economic growth. For example, Dollar and Kraay (2003) suggest that both institutions and trade affect income at the long run, but with small impact from trade in the short run. Similarly, Rigobon and Rodrik (2005) found a strong relationship between the rule of law and incomes. According to Daude and Stein (2007), institutions might affect growth by increasing FDI.

Recent empirical research still emphasizes the key role of institutions such as Kwon and Kim (2014), Flachaire *et al.* (2014) and Anwar and Cooray (2015). While Kwon and Kim (2014) were interested to the poverty reduction through the good governance, Flachaire *et al.* (2014) found that political institutions are one of the deep sources of growth. To our knowledge, the most recent work that deals with the institution's quality, FDI and income is Anwar and Cooray (2015) which suggest that the interaction between FDI and the institution's quality has a positive effect on per capita income. This means that in presence of good institutions' quality, the income per capita rises when the FDI inflows increase.

A strong example of the institution's role is the Korean Peninsula's experience where two types of institutions influenced the current state of North and South Korea. While the two countries were approximately at the same level of development at the separation date with some technology advance for North Korea then, the two countries have taken two opposite

ways of institutional and economic development (see Acemoğlu *et al.*, 2005). Nowadays, North Korea is less developed and more vulnerable to famine and food insecurity compared to South Korea; a situation traced back to difference in the quality of institution conflict, poor policy design and lagging implementation which disrupted production and distribution of food. Here domestic institution is the main driver of food insecurity but it's not always the case because institution may contribute with other factors to harm food security (Boyd and Wang, 2011; Pereira and Ruysennar, 2012; Candel, 2014). For example, Pazvakavambwa (2011) explained how the bad Tanzanian governance has led to the agricultural failure and food insecurity. For the author a part of the problem is that basic inputs are not accessible for all farmers because prevalence of nepotism and influential persons, and because a delayed stage-manage imports and delivery of inputs which force them to buy at high prices from the informal markets.

To resume, the more institutional quality is good, the more there is chance for better FDI effects, economic performance, and thus food security's state and prosperity.

3.2.2 FDI's effects on host economy

The academic literature on the FDI's effects is abundant and very ambiguous. From an economic point of view, it is often considered that FDI enhance growth. However, sociologists are divided between two opposite schools, the modernization and the dependency. Both theories have influenced the economic literature since they analyze the effect of globalization's phenomenon at the social level while economists are mostly limited to calculate the economic impact of FDI with neglect of the social dimension of this phenomenon.

Certainly, FDI have positive and negative spillovers. In addition, sectors in which these investments are involved will be affected differently. Beginning by the negative effects, FDI appear not a good instrument to boost growth and improve welfare (Jenkins and Scalan, 2001) because this type of capital increases spatial inequality in economic development and leads to the dependency of host developing countries to developed countries. A phenomenon known as "Land Grabbing", often cited in the literature in recent years, was considered as a harmful result of some factors like FDI in food production and the increased foreign investors demand on biofuels and non-food agricultural commodities (Zoomers, 2010). In addition, FDI can affect negatively the current account balance (Tausch, 2003). For example, if foreigners bring home profits and the foreign firms do not boost exports but increase imports of raw

material to local production. It can also be problematic in the international taxation context when the transfer pricing phenomena appear between entities within a company. In terms of competitiveness, domestic firms are most often weaker than foreign firms (Leonard, 2006) and consequently they are not able to meet competition. Often, the losers will reduce the number of employees, and hence unemployment is increased.

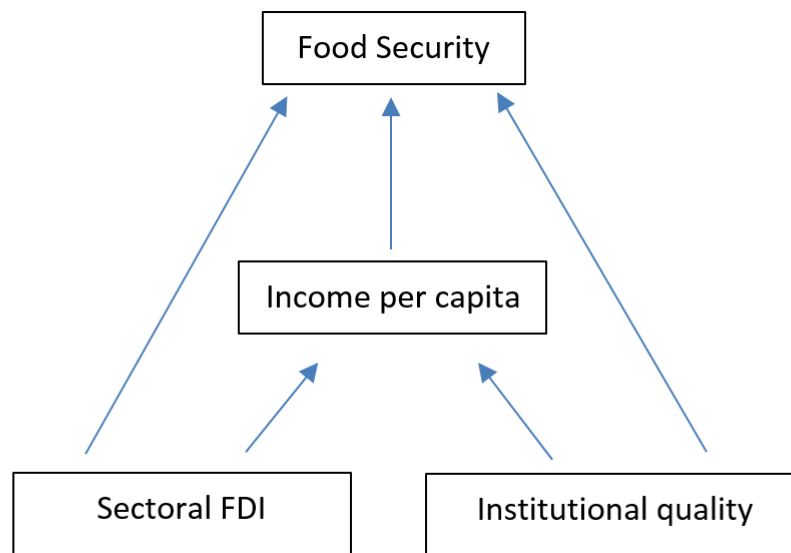
However, in the last decade, the tendency is rather that FDI generate more benefits than adverse costs, which explains the course to attract FDI in DCs. Lots of economists believe that FDI boost the economic growth and impose positive social welfare effects. For example, Cieřlik and Tarsalewska (2011) found that FDI and trade contribute to economic growth by improving the GDP per capita. FDI are an instrument to attract investments, increase wages, technology transfer and diffuse knowledge, improve human capital and firm productivity, boost exports, and thus improve economic growth (Javorcik, 2004 ; Leonard, 2006). At the micro level, FDI have a potential impact on wages. In the Indonesian manufacturer sector, wages are improved in presence of FDI inflows (Lipseý and Sjöholm, 2004). In the end, the beneficiaries will be able to access to food more than others will.

At the sectoral level of FDI, the work of Wang (2009) points the effect of sectoral FDI on economic growth. He found that FDI in manufacturing enhance the economic growth. This result was expected because the sample is composed of 12 Asian economies well known by the attractiveness of manufacturing FDI.

Two other works have investigated the relationship between FDI and food security, Mihalache-O'keef and Li (2011) and Ben Slimane *et al.* (2016). The first authors found that FDI in primary sector affect food security negatively, FDI in secondary sector have a positive effect but FDI in the tertiary have an ambiguous effect. However, the second authors focused on the agricultural channel by which sectoral FDI can improve the food security and their results showed that FDI in agriculture could be a good instrument for improving availability and utilization of food. However, FDI in the industrial sector have a positive spillover in terms of technology transfer and know-how in the production process but some negative spillovers are explained by the environment's pollution. FDI in services have negative spillovers in terms of change in society structure by increasing gap between poor and rich, and encouraging indirectly the move of rural people to the urban city because the job opportunities

are better than in rural area. Nevertheless, this attraction of people is followed by a rise of demand on food products, which contributed to a rise in prices and less food security access.

FIGURE 3.1 – Hypothesized relationships between FDI, institutional quality and food security through the income channel



To sum up, the literature shows several proofs that FDI are closely related to the quality of institutions but it seems there is a gap in the literature on the question of how institution quality affects the food security through FDI transmission channel. As revealed in the literature, host countries benefit from technology transfers, and know-how generated by FDI. This explains why DCs compete to redirect these flows to their economies. In Figure 3.1 we resume our hypotheses on the links between our main variables. The economic performance must be reached in a first step then food security could be improved in a second one. FDI influences the income and food security by spillovers. The interaction of FDI with good institutional quality leads to positive spillovers and vice versa. In the next section, we present our method and our data used in order to answer to our problematic.

3.3 The empirical model

To investigate the links between sectoral FDI, institutional quality, income and food security, we propose the following estimation strategy. As shown in figure 1, sectoral FDI inflows and the institutional quality influence the income per capita. We specified the

income's determinants by reference to the empirical literature of traditional growth model. Precisely, our first specification is based on the determinants of income per capita (see for example Borensztein *et al.*, 1998 ; Makki and Somwaru, 2004 ; Alguacil *et al.*, 2011) :

$$Y_{it} = \alpha_0 + \sum_{k=1} \alpha_k FDI_{kit} + \gamma INS_{it} + \sum_{k=1} \delta_k INS_{it} \times FDI_{kit} + \sum_{j=1} \sigma_j X_{jit} + \mu_i + v_t + \varepsilon_{it} \quad (1)$$

Where : i , t , k , j stand for the country, the time, the sector and the control variable, respectively. Y_{it} is the income per capita. FDI_{kit} is the vector FDI inflows according to the sector k . INS_{it} is the institutional quality. ($INS_{it} \times FDI_{kit}$) is the interaction between the institutional quality and the sectoral FDI inflows. X_{jit} is a vector of control variables (Gini index, trade openness, and domestic investment). α_0 is the constant term. α_k , γ , δ_k and σ_j are the coefficients to be estimated. μ_i and v_t are the country and year effects, and ε_{it} is the term of error.

Our second equation concerns the determinants of food security. Therefore, we write the equation as :

$$Z_{it} = \beta_0 + \varphi Y_{it} + \sum_{k=1} \beta_k FDI_{kit} + \pi INS_{it} + \sum_{k=1} \theta_k INS_{it} \times FDI_{kit} + \sum_{j=1} \rho_j X_{jit} + \mu_i + v_t + \varepsilon_{it} \quad (2)$$

Z_{it} is the food security variable ; Y_{it} is the income per capita ; INS_{it} is the institutional quality, $INS_{it} \times FDI_{kit}$ is the interaction between the institutional quality and the sectoral FDI inflows. β_0 is the constant term. φ , β_k , π , θ_k and ρ_j are the coefficients to be estimated. μ_i and v_t are the country and year effects, and ε_{it} is the term of error.

3.3.1 Data

Table C1 in appendix C summarizes the data used in the paper and table C2 shows the correlation coefficients between all variables. Our sample is composed of an unbalanced panel of annual data for a number of developing countries (between 47 and 57 according to the specifications) between 1995 and 2010. The dataset has a large number of missing observations due to the lack of data for sectoral FDI inflows.

Our first key variables are the sectoral FDI inflows, which we express as a percentage of GDP to measure the FDI in primary, secondary and tertiary sectors of the economy. The compositions of each sector are shown in Tables C3, C4 and C5 in the Appendix C.

Then, we use the six indicators built by Kaufmann *et al.* (2010) to measure the quality of institution. Indeed, all these indicators are highly correlated (see table C6 in appendix C); this means that we are unable to include these indicators in the same regression, so we follow Easterly and Levine (2003) and we calculated the average of the six institutional quality indicators. The first indicator is the governance effectiveness, which *“captures the quality of public and civil services and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government’s commitment to such policies”*. The second is the control of corruption, which captures *“the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as « capture » of the state by elites and private interests”*. The third is the political stability and absence of violence and terrorism, *“which captures the likelihood of political instability and/or politically-motivated violence, including terrorism”*. The fourth is the regulatory quality, which supposed to capture *“the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development”*. The fifth one is the rule of law, which supposed to capture *“the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence”*. The sixth is the voice and accountability, which supposed to capture *“the extent to which country’s citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media”* (Kaufmann *et al.*, 2010). The Kaufmann’s indicators are ranging from -2.5 (bad quality) to 2.5 (good quality)¹.

The economic performance is presented by the income level and measured by the GDP per capita in purchasing power parity (PPP). The GDP per capita gives information of the approximate individual income in a country, and reflects the results of government’s policy to reduce poverty (FAO, 2012, 2013). However, this indicator has two main limits; it does not reflect the real living conditions of the entire population, and does not inform whether the recorded economic performance has affected the entire population or not. In brief, this

1. Each Kaufmann’s indicator is built from many indicators taken from many sources. For more information see <http://info.worldbank.org/governance/wgi/index.aspx#faq-7>

indicator is weak if we don't control the income inequality in a country. Nevertheless, it must be said that GDP per capita has played an important role in the reduction of poverty in some developing countries (FAO, 2013). We consider that the economic access endogenously affects the availability and utilization of food because we believe that population with low income may have some difficulties to access and use food. We control the physical access by the government effectiveness². For instance in Kwara State of Nigeria, at the micro level, the income received from off-farm activities helps to better access to food and nutrition during the lean season (Babatunde and Qaim, 2010). This means that farmers who have an off-farm income are more secured in terms of access to food. In brief, to control the income inequality, we include the Gini Index from Solt (2014). The indicator is ranged from 0 (perfect equality) to 100 percent (perfect inequality).

Among the main factors stimulating economic performance, we also take into account the domestic investment measured by the gross fixed capital formation as a percentage of GDP and the degree of trade openness measured by the sum of exports and imports as a percentage of GDP. Openness is a conditional factor to encourage foreign investors to invest in host countries. The literature suggests that trade openness is often positively associated with income (Frankel and Romer, 1999 ; Bekaert *et al.*, 2005 ; Wacziarg and Welch, 2008).

3.3.2 Principal components analysis to build a food security composite indicators

Food security is a very complex and multidimensional concept with approximately 200 definitions and 450 indicators (Hoddinott, 1999). A large part of these indicators is for microeconomic analysis and is often calculated from field surveys. Nevertheless, with regards to the food security concept, we need to choose the appropriate measure. The literature has discussed many indicators (see, De Haen *et al.* (2011) and Masset (2011)) but very few authors have attempted to build composite indicators of food security. The most known composite indicators are Global Hunger Index developed by Wiesmann *et al.* (2006), the Poverty and Hunger index (PHI) developed by Gintilini and Webb (2008), and the Global food security index (GFSI) developed by the Economist Intelligence Unit (2012). Unfortunately, the data of these indicators is not available for a long period. While the technique used differ from

2. The infrastructure quality is included by Kaufmann to build the indicator of government effectiveness.

one author to another, the goal remained the same : the construction of an indicator that reflects the best the food security. Using a microeconomic approach, Mahadevan and Hoang (2015) applied the Latent Class Model on data from Vietnamese Household Living Standard Survey 2010. The authors have built composite food security indicators for rural and urban households by controlling the quantitative and latent aspect of food security. However, in our paper we apply a macroeconomic approach, so we used only macroeconomic indicators provided by the Economic and Social Development Department of FAO. Our objective is to build composite indicators to express the major part of food security concept.

The definition of food security reflects four main dimensions that the FAO used to deal with the food security's issues : food availability, food access, food utilization and food stability. Each dimension is characterized by its own indicators, so to face the difficulty of using all indicators in the literature, we focused on the most commonly used indicators on three dimensions leaving aside the stability. This choice is justified by the fact that they are complementary in the sense that the availability of food must be accessible and used with some good conditions for all people. However, we neglected the food stability pillar because it is more related to external shocks, for example an increase in prices in international markets, or a natural disaster. In addition, the transmissions channels by which food stability is influenced are not at the heart of our paper.

The food availability is measured by the average dietary energy supply adequacy, the average value of food production per capita, and the share of dietary energy supply derived from cereals, roots and tubers. The last provides information about the quality of the available diet. A good diet is that includes animal and vegetal sources, so an increase in the share of dietary energy supply derived from cereals, roots and tubers means a bad quality of available diet. The food utilization is mainly focused on the way by which the human health is protected. FAO (2013) considered that the handling, the preparation and the stock of food influence the food utilization, in particular the body health. Therefore, the access to clean water and good sanitation is very important to achieve this goal. Another indicator used by FAO to measure this dimension is the prevalence of anaemia. This health indicator measures the percentage of pregnant women and children under 5 years of age whose hemoglobin level is smaller than 110 grams per liter at sea level. Nutritional deficiencies are one of common causes of anaemia. The access to improved water source and improved sanitation facilities

are two important indicators of food security at the global context and of food utilization at a specific dimension. On the other side, the food access is split by the FAO (2013) on two pillars. The first one is the economic access and expressed by the GDP per capita based on PPP, and the second one is the physical access and expressed by infrastructure's quality in a country. Nevertheless, having a high income and good infrastructure quality do not mean that food security is reached. For this reason, we do not include the access dimension in our composite indicator and we considered it as the instrument that allows reaching the other food dimensions.

We build a composite indicator using the principal components analysis (PCA) corrected for outlying observations (Verardi, 2009). The PCA captures the variance of each of correlated variables and predicts an indicator with the maximum information from all variables. Our methodology consists in testing the correlation between all food security indicators in FAOSTAT database. However, we were constrained by two factors in the data i) some indicators have a low number of observations ii) it is difficult to find a correlation between all indicators. These two factors can affect the amount of information in the composite indicator and later in the estimation stage.

The methodology used to build a robust composite indicator is based on few steps. First, we test the correlation between the variables. As shown in table 3.1, there are high correlations between our variables. Second, we choose the composite indicator according to two criteria i) the cumulative variance so that at least 60 to 70% of the total information is explained ii) the Kaiser criterion (Kaiser, 1960) which is used to keep the principal components that have an eigenvalue higher than one.

We made a preliminary attempt to build a composite indicator from our seven indicators of food security. Results show the presence of two composite indicators with an eigenvalue higher than one. However, the cumulative information for the first component is very weak (see table 3.2).

To correct this issue we split our indicators on two groups according to the correlation's sign, the first group includes indicators whose their growth leads to a better food security situation, while the second group includes indicators whose their growth is harmful to food

TABLE 3.1 – Correlation test between the food security indicators

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Average dietary energy supply adequacy	1.00						
(2) Average value of food production per capita	0.49	1.00					
(3) Access to improved sanitation facilities	0.56	0.57	1.00				
(4) Access to improved water sources	0.57	0.50	0.86	1.00			
(5) Share of dietary energy supply derived from cereals, roots and tubers	-0.38	-0.66	-0.68	-0.71	1.00		
(6) Prevalence of anaemia among pregnant women	-0.46	-0.55	-0.80	-0.74	0.69	1.00	
(7) Prevalence of anaemia among children under 5 years of age	-0.34	-0.42	-0.72	-0.62	0.52	0.79	1.00

Source : authors' calculations.

TABLE 3.2 – Total variance of principal components for seven indicators of food security

Components	Eigenvalue	Proportion	Cumulative
PC1	3.07	0.44	0.44
PC2	1.34	0.19	0.63
PC3	0.93	0.13	0.76
PC4	0.63	0.09	0.86
PC5	0.58	0.08	0.94
PC6	0.26	0.03	0.97
PC7	0.15	0.02	1.00

Source : authors' calculations.

security. Then, we applied the PCA technic for each group of indicators.

In table 3.3, results show an improvement of cumulative information. For the first component, the Eigenvalue is more than one with more than 60 percent of information ; hence, we choose only the first component for each group.

TABLE 3.3 – Total variance of principal components

Components	Group 1			Group 2		
	Eigenvalue	Proportion	Cumulative	Eigenvalue	Proportion	Cumulative
PC1	2.59	0.65	0.65	1.81	0.61	0.61
PC2	0.82	0.20	0.85	0.79	0.26	0.87
PC3	0.49	0.12	0.97	0.39	0.13	1.00
PC4	0.08	0.02	1.00	–	–	–

Source : authors' calculations.

Now let us move to the calculation of food security composite indicators. Table 3.4 shows indicators' weights which are the information quantity of each indicator in the component indicator score. For example, for the first composite indicator, the energy supply adequacy represents 12 percent ; however, access to improved water sources is about 33 percent of the global score.

3.4 Estimation results

Tables 3.5, 3.6, and 3.7 present our estimations results. All regressions are with year and country fixed effects. Table 3.5 is the estimations of equation (1). We test if the income per capita is influenced by sectoral FDI and institutional quality. We also check whether the

TABLE 3.4 – Weights of indicators on the two components

Variables	Weights
<u>The first composite food security indicator (FSI1) :</u>	
Average dietary energy supply adequacy	0.12
Average value of food production per capita	0.23
Access to improved sanitation facilities	0.32
Access to improved water sources	0.33
<u>The second composite food security indicator (FSI2) :</u>	
Share of dietary energy supply derived from cereals, roots and tubers	0.24
Prevalence of anaemia among pregnant women	0.42
Prevalence of anaemia among children under 5 years of age	0.34

Source : authors' calculations.

inclusion of control variables affects the estimation results.

In column (1), we estimated our baseline specification, where we explain income by sectoral FDI and institutional quality. Results show that FDI in secondary sector and institutional quality influence income per capita with an opposite effect. The first has a negative and significant coefficient, while the second has a positive one. Then, we consider the income inequality expressed by the Gini index (column (2)), interaction variables (column (3)), Trade openness (column (4)) and domestic investment (column (5)).

Once these are included, the estimated coefficient for institutional quality remains statistically significant. However, FDI in primary sector became statistically significant with a positive effect after the inclusion of interaction variables, in columns (3), (4) and (5). The coefficient of the first interaction variable is positive and significant at the level of 1 percent. This suggests that in presence of good quality of institution, FDI in primary sector are better in terms of efficiency on income's increase. The same finding is for the second interaction variable where the coefficient is positive and significant at the level of 1 percent. This means that FDI's effect of secondary sector becomes positive when the institutional quality reaches a threshold of 0.25. Trade openness and domestic investment have positive and statistically significant coefficients at levels of 10 and 1 percent, respectively.

Table 3.6 is the estimations of equation (2). We evaluate the direct effects of sectoral FDI and institutional quality on food security. Columns (1)-(2) test the links between the income per capita and sectoral FDI separately with the food security indicator.

TABLE 3.5 – Links between sectoral FDI and income in presence of institution

	Dependent variable= Income per capita				
	(1)	(2)	(3)	(4)	(5)
Primary FDI	-0.001 (-0.90)	-0.001 (-1.11)	0.004*** (3.06)	0.004*** (3.00)	0.003** (2.34)
Secondary FDI	-0.002*** (-3.10)	-0.002*** (-3.03)	-0.001 (-1.59)	-0.001 (-1.63)	-0.001* (-1.72)
Tertiary FDI	0.000 (0.85)	0.000 (1.29)	0.000 (1.39)	0.000 (1.21)	-0.000 (-0.09)
Institutional quality	0.253*** (4.30)	0.250*** (4.24)	0.144*** (2.69)	0.147*** (2.75)	0.084* (1.65)
Gini index		-0.003 (-0.52)	-0.001 (-0.28)	-0.001 (-0.29)	-0.004 (-0.88)
<i>PrimaryFDI</i> × <i>Institution</i>			0.005*** (3.31)	0.005*** (3.31)	0.006*** (3.37)
<i>SecondaryFDI</i> × <i>Institution</i>			0.004*** (2.68)	0.004*** (2.86)	0.004*** (3.35)
<i>TertiaryFDI</i> × <i>Institution</i>			0.000 (0.49)	0.000 (0.39)	0.000 (0.17)
Trade openness				0.001 (1.61)	0.001* (1.65)
Domestic investment					0.009*** (4.71)
R-squared	0.851	0.850	0.864	0.865	0.879
Number of observations	409	386	386	386	380
Numbers of countries	50	50	48	48	48

Notes : t-statistics are in parentheses. Significance at the 1, 5 and 10 percent levels are denoted respectively by ***, **, *. The constant is not reported.

The column (1) shows that the effect of income is positive and statistically significant at the level of 1 percent. In column (2), we include only sectoral FDI and we found that FDI in primary and secondary sectors are not statistically significant. However, the coefficient of FDI in tertiary sector is negative and significant at the level of 1 percent. In column (3), we regressed all previous variables and we found that the coefficients of income and FDI in secondary sector are significant and remain the same signs as in previous regressions. FDI in primary sector has a significant coefficient, but with a low positive effect. In column (4), we add institutional quality and results almost remain the same, but there is no significant effect for institutional quality. We add the Gini index, in column (5), to control the income inequality and we found that the income inequality has a negative and significant effect on food security. This finding is consistent with our intuition, because the bad distribution of income interrupts the access and the utilization of food. Then we include interacted variables, and we found that the coefficient of FDI in secondary sector became significant. In addition, when FDI in secondary and tertiary sector interacted with institution, they have, respectively, a positive and a negative effect on food security (see column (6)). In the last two columns (7) and (8), we add trade openness and domestic investment to see how they influence our results. Coefficients remain significant with approximately the same effects, but it appears that the coefficient of domestic investment has not the expected sign and it is slightly significant. For the interaction between FDI in primary sector and institutional quality, the estimated coefficient is not significant. However, the interacted variables for the two others types of FDI are statistically significant at the level of 1 percent. FDI in secondary sector seems to be efficient and diffuses more spillovers that are positive in presence of a good quality of institution. This is particularly true when institutional quality is lower but not lower than a threshold of -0.3. For FDI in tertiary sector, the link seems to be negative even with good institutional quality.

Overall, our results show a weak link between sectoral FDI and food security, but in presence of good quality of institution, links become more clearer and stronger. This confirms the important role of domestic institution to absorb FDI. However, it is important to check these links with another measure of food security.

In table 3.7, we try to explain the second composite indicator FSI2 by the same macroe-

TABLE 3.6 – Links between sectoral FDI and food security in presence of institution

	Dependent variable : FSII							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Income per capita	0.405*** (4.01)		0.633*** (4.38)	0.619*** (3.30)	0.484*** (2.63)	0.450** (2.27)	0.444** (2.28)	0.504** (2.53)
Primary FDI		0.001 (1.10)	0.000** (2.00)	0.000 (1.57)	-0.000 (-0.94)	0.000 (0.02)	0.000 (0.00)	0.000 (0.15)
Secondary FDI		0.001 (0.55)	0.002 (1.26)	0.001 (0.43)	0.000 (0.25)	0.004** (2.31)	0.004** (2.28)	0.004** (2.30)
Tertiary FDI		-0.002*** (-3.22)	-0.003*** (-3.47)	-0.002** (-2.26)	-0.002* (-1.91)	-0.002*** (-2.70)	-0.002*** (-2.67)	-0.002*** (-2.49)
Institutional quality				0.023 (0.19)	0.067 (0.56)	0.036 (0.32)	0.039 (0.34)	0.054 (0.47)
Gini index					-0.022*** (-3.99)	-0.023*** (-4.06)	-0.023*** (-4.08)	-0.022*** (-3.61)
<i>PrimaryFDI × Institution</i>						0.000 (0.31)	0.001 (0.34)	0.000 (0.03)
<i>SecondaryFDI × Institution</i>						0.013*** (2.99)	0.013*** (2.97)	0.013*** (2.91)
<i>TertiaryFDI × Institution</i>						-0.006*** (-3.01)	-0.006*** (-3.00)	-0.006*** (-3.04)
Trade openness							0.001 (0.40)	0.001 (0.44)
Domestic investment								-0.005* (-1.73)
R-squared	0.669	0.699	0.721	0.720	0.745	0.766	0.767	0.760
Number of observations	856	531	512	404	381	381	381	375
Numbers of countries	56	52	51	50	48	48	48	48

Notes : t-statistics are in parentheses. Significance at the 1, 5 and 10 percent levels are denoted respectively by ***, **, *. The constant is not reported.

economic variables used previously. Here, we look for the channel by which sectoral FDI and institutional quality influence food security. As mentioned before, an increase in this indicator means that food security state is worsen, so we expect opposite signs for estimated coefficients compared to the results in the previous section. We check the endogeneity of income on our dependent variables by the Durbin-Wu-Hausman test under the null hypothesis that income is exogenous. According to this test, income per capita is endogenous in our models. To solve this issue we use instruments which are expected to affect income but not the dependent variables. We use the labor force as a percentage of population and domestic investment as a percentage of GDP as instruments to income. This choice is validated by three different tests³.

First, we tested the null hypothesis that the equation is under-identified by using the Kleibergen and Paap (2006) rk-statistic, and we used the Kleibergen and Paap (2006) rk Wald F statistic to check the weakness of instruments. The test consists in comparing the Stock and Yogo (2005) critical values with Kleibergen-Paap Wald rk F statistic ; we found that all statistics are well above the critical value of 15% (see results in table 3.7). Third, we used the Hansen (1982) test to see if the instruments are valid instruments and we found that all p-value are higher than 15%, which means that the instruments are valid.

The first estimated model is presented in column (1) of table 3.7. In the rest of columns, we put additional variables as we did in previous tables. Note that country and year fixed effects are included in all regressions.

The Panel A reports the first stage of instrumental variable (IV) estimation and Panel B reports the two stage Least squares estimation. Column (1) shows that the estimated coefficient of institution variable has a positive and significant impact on income, but for sectoral FDI, only the coefficient of FDI in primary and secondary sectors has a negative and significant effect on income. At the second stage, the effect of income is significant and affects, as expected, the composite indicator of food insecurity negatively.

In column (2), the income inequality (measured by the Gini index) was found to negatively influence the income. This is consistent with our previous estimation and with our expectation that an increase in income inequality hinders the economic performance.

3. We performed all tests by using the Stata command of Schaffer (2010).

TABLE 3.7 – Estimation results of IV fixed effects model with FSI2

	(1)	(2)	(3)	(4)
Panel A : First stage : endogenous variable = Income per capita				
Primary FDI	-0.001*	-0.002***	0.003**	0.003**
	(-1.84)	(-2.76)	(2.44)	(2.42)
Secondary FDI	-0.002***	-0.002***	-0.001	-0.001
	(-2.85)	(-2.98)	(-1.56)	(-1.59)
Tertiary FDI	0.000	0.000	0.000	0.000
	(0.18)	(0.88)	(0.66)	(0.57)
Institutional quality	0.203***	0.197***	0.091*	0.094*
	(3.18)	(3.29)	(1.78)	(1.85)
Labor force (% population)	0.006	0.006	0.003	0.002
	(1.03)	(1.03)	(0.60)	(0.33)
Domestic investment	0.007***	0.008***	0.009***	0.009***
	(3.19)	(3.97)	(4.70)	(4.53)
Gini index		-0.011*	-0.009*	-0.009*
		(-1.85)	(-1.86)	(-1.87)
<i>PrimaryFDI</i> × <i>Institution</i>			0.006***	0.006***
			(3.49)	(3.50)
<i>SecondaryFDI</i> × <i>Institution</i>			0.003**	0.003***
			(2.52)	(2.63)
<i>TertiaryFDI</i> × <i>Institution</i>			0.000	0.000
			(0.24)	(0.16)
Trade openness				0.001
				(1.20)
R-squared	0.863	0.867	0.883	0.884
Panel B : Two-stage Least squares : Dependent variable = FSI2				
Income per capita	-1.829*	-1.738*	-1.536*	-1.428*
	(-1.82)	(-1.89)	(-1.92)	(-1.73)
Primary FDI	-0.001	-0.001	0.003	0.003
	(-0.72)	(-0.89)	(0.60)	(0.56)
Secondary FDI	-0.001	-0.001	-0.004	-0.003
	(-0.32)	(-0.45)	(-1.60)	(-1.58)
Tertiary FDI	0.001	0.001	0.001	0.001
	(0.57)	(0.79)	(1.13)	(1.16)
Institutional quality	0.008	0.038	-0.072	-0.093
	(0.03)	(0.15)	(-0.41)	(-0.52)
Gini index		-0.010	-0.004	-0.003
		(-0.56)	(-0.29)	(-0.23)
<i>PrimaryFDI</i> × <i>Institution</i>			0.005	0.004
			(0.75)	(0.66)
<i>SecondaryFDI</i> × <i>Institution</i>			-0.011**	-0.012**
			(-2.14)	(-2.21)
<i>TertiaryFDI</i> × <i>Institution</i>			0.007***	0.007***
			(3.09)	(3.19)
Trade openness				-0.001
				(-0.61)
R-squared	0.338	0.357	0.422	0.439
Number of observations	388	366	366	366
Endogeneity test	4.039**	5.057**	6.138**	5.201**
Hansen p-value	0.2838	0.1974	0.1364	0.1315
Weak identification test (≤ 15%)	11.076	13.657	15.952	13.749
Under identification test	18.259***	21.687***	23.326***	19.301***
Number of countries	49	47	47	47

Notes : Panel A reports the corresponding first stage of IV estimation. Panel B reports the corresponding two stage least squares estimates, instrumenting for income per capita using Domestic investment and labor force. The constant is not reported. t-statistics are in parentheses. Significance at the 1, 5 and 10 percent levels are denoted respectively by ***, **, *.

In columns (3)-(4), we include the interaction variables between sectoral FDI and the institutional quality. The only difference between these two regressions is that we added trade openness in specification (4). In this latter, we test whether trade openness has an impact on our specification and the reported result shows that the p-value is well above one percent as happened in specifications (7) and (8) of table 3.6. Turning to the same column (3) in Panel B, we find that income's coefficient has negative signs and is significant at the level of 10 percent. When FDI in secondary sector interact with institution quality, their effect becomes significant and reduces the food insecurity, but it is not the case for FDI in tertiary sector where it enhances food insecurity.

After the inclusion of trade openness in column (4), results remain the same with a slight decrease in the institution's effect in panel A and in the income's effect on food insecurity in panel B. More important, however, the coefficient of the interactive term between FDI in primary sector and the economic institutional quality is positive and significant, and with the same effect as in the two previous estimates. This indicates that the effect of FDI in primary sector becomes positive when the institutional quality reaches a threshold of -0.5. An average institutional quality higher than this value gives host countries the possibility to benefit from positive spillovers of FDI in primary sector. For FDI in secondary sector, the threshold is about 0.33. Under this value, the effect becomes negative on income. This result confirms the importance of the capacity of absorption in benefiting from FDI. At low levels of institutional quality, FDI have negative effects on income. The reverse holds for high levels of institutional quality.

In the second stage, the income seems to have a negative impact on food insecurity. In the latter, however, FDI in tertiary sector have negative spillovers on food security even after interaction with the economic institution.

If the institutional quality is less than a threshold of -0.25, spillovers from FDI in the secondary sector become harmful to food security. FDI in tertiary sector has always a negative effect on food security. Indeed, FDI in tertiary sector can influence income level positively (unfortunately we didn't find a significant coefficient), but on food security, it has negative spillovers. This type of FDI inflows is generally located in urban cities, encourages the rural exodus, and thus amplifies poverty and inequality in the society. The negative and significant

sign of income inequality confirms our intuition.

3.5 Conclusion

This paper examines whether the institutional quality leads to better exploit FDI and thus improving food security in developing countries. Motivated by the important role of economic and political institutions on shaping economy, we examined the effects and the interaction effects of sectoral FDI and the institutional quality on income and food security. We conducted our view in accordance with the economic literature. At the empirical level, we used an unbalanced panel of several developing countries and we specified a fixed effects model with and without the instrumental variable techniques.

Our first important finding was that FDI inflows have mixed effects and using a disaggregated FDI gives a clearer picture of these effects. Indeed, the economic literature did not sufficiently investigate the disaggregated level of FDI data. Our results confirm that sectoral FDI and food security have indirect links, i.e. through spillovers effects, on the host economy. The good institutional quality makes FDI more efficient in primary and secondary sectors by increasing income and thus ensuring access to available food. It seems that institutional quality is primordial to determine the sense of spillovers effect. Results show that FDI in secondary sector becomes a factor of growth only if institutional quality exceeds some thresholds. For FDI in tertiary sector, the effect is always harmful to food security. Otherwise, FDI in the services sector are concentrated in capitals and urban areas, which encourages the rural population to leave their area and go to urban ones. This rural exodus makes food less available because of the high demand and less accessible because food prices will be higher. Testing for the effect of Gini index, we found that income inequality presents a strong constraint to income and to the improvement of food security, which is consistent with the negative effect of FDI in services.

To sum up, FDI may be a source of capital accumulation and technology transfer, but it is far from being the best instrument to enhance food security in presence of the actual economic and political institution quality. Reforms aiming at fighting corruption and increasing the government transparency are necessary to benefit from FDI and to begin the race towards eradicating food insecurity.

We should mention that this work has several limitations. The composite indicator could include more information about the food security but unfortunately, there are insufficient data in several indicators. Another limit is the database of sectoral FDI. First, data are not sufficiently available and second, the method of calculation of FDI is still criticized (Fontagné and Toubal, 2010). Consequently, this prevents us from extending the analysis over a larger period.

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Annex C

TABLE C.1 – Summarized data

Variable	Obs	Mean	Standard deviation	Min	Max
Average dietary energy supply	886	114.10	14.36	72	163
Average value of food production	886	274.72	146.01	67	997
Access to improved sanitation facilities	896	66.82	26.69	3	100
Access to improved water sources	901	83.05	16.64	20	100
Share of dietary energy supply derived from cereals, roots and tubers	886	53.59	13.70	26	84
Prevalence of anaemia among pregnant women	890	39.89	15.25	17.8	77.2
Prevalence of anaemia among children under 5 years of age	890	35.95	8.88	20.5	61.9
Log GDP per capita=Income per capita	887	8.39	0.84	5.82	9.97
Primary FDI (% GDP)	578	12.25	37.63	-15.51	470.95
Secondary FDI (% GDP)	590	8.96	9.95	-14.88	97.70
Tertiary FDI (% GDP)	627	20.97	26.01	-16.13	241.53
Average of Kaufmann's indicators = institutional quality	688	-0.36	0.44	-1.33	1.02
Gini index	825	40.95	7.70	20.66	56.95
Trade openness	911	79.26	37.86	14.93	220.40
Gross fixed capital formation (% GDP)	883	21.52	6.32	5.38	57.70
Labor force (% population)	928	42.69	6.01	27.65	58.40

TABLE C.2 – Correlation between variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Primary FDI	1.00							
(2) Secondary FDI	-0.01	1.00						
(3) Tertiary FDI	-0.04	0.24	1.00					
(4) Gini index	-0.24	-0.09	-0.19	1.00				
(5) Institutional quality	-0.22	0.22	0.21	-0.07	1.00			
(6) Income per capita	-0.05	0.00	0.18	-0.02	0.53	1.00		
(7) Trade Openness	0.08	0.25	0.23	-0.23	0.30	0.21	1.00	
(8) Domestic investment	0.41	0.12	0.16	-0.10	0.00	0.03	0.16	1.00

Source : authors' calculations

TABLE C.3 – Decomposition of the primary sector

Primary sector
Agriculture, hunting, forestry and fishing
Agriculture and hunting
Forestry
Fishing
Mining, quarrying and petroleum
Mining and quarrying
Petroleum

Source : Industrial and geographical breakdown UNCTAD. Available at :
<http://unctad.org/en/Pages/DIAE/Industrial-and-Geographical-Breakdown.aspx>

TABLE C.4 – Decomposition of the secondary sector

Secondary sector	
Food, beverages and tobacco	Metal and metal products
Food products and beverages	Basic metals
Tobacco products	Fabricated metal products
Textiles, clothing and leather	Machinery and equipment
Textiles	Electrical and electronic equipment
Clothing	Office, accounting and computing machinery
Leather and leather products	Electrical machinery and apparatus
Wood and wood products	Radio, television and communication apparatus
Manufacture of wood and wood products	Precision instruments
Paper and paper products	Motor vehicles and other transport equipment
Publishing, printing and reproduction of recorded media	Motor vehicles, trailers and semi-trailers
Coke, petroleum products and nuclear fuel	Other transport equipment
Chemicals and chemical products	Other manufacturing
Rubber and plastic products	Recycling
Non-metallic mineral products	

Source : Industrial and geographical breakdown UNCTAD. Available at :
[http://unctad.org/en/Pages/DIAE/Industrial – and – Geographical – Breakdown.aspx](http://unctad.org/en/Pages/DIAE/Industrial%20and%20Geographical%20Breakdown.aspx)

TABLE C.5 – Decomposition of the tertiary sector

Tertiary sector	
Electricity, gas and water	Rental activities
Construction	Computer and related activities
Trade	Research and development
Automotive trade and repair	Other business activities
Wholesale trade	Public administration and defence
Distributive trade	Education
Hotels and restaurants	Health and social services
Transport, storage and communications	Community, social and personal service activities
Transport and storage	Sewage and waste disposal, sanitation activities
Land transport including pipelines	Membership Organizations N.E.C.
Water transport	Recreational, cultural and sporting activities
Air transport	Other services
Supporting and auxiliary transport activities	Service activities incidental to oil and gas extraction excluding surveying
Post and communications	Other service activities
Finance	Private households with employed persons
Financial intermediation	Extra-territorial organizations and bodies
Insurance and pension funding	Private buying and selling of property
Activities auxiliary to financial intermediation	Unspecified
Business activities	
Real estate	

Source : Industrial and geographical breakdown UNCTAD. Available at : [http://unctad.org/en/Pages/DIAE/Industrial – and – Geographical – Breakdown.aspx](http://unctad.org/en/Pages/DIAE/Industrial-and-Geographical-Breakdown.aspx)

TABLE C.6 – Correlation between institutional indicators of Kaufmann

	(1)	(2)	(3)	(4)	(5)	(6)
(1) Control of corruption	1.00					
(2) Government effectiveness	0.78	1.00				
(3) Political stability	0.54	0.38	1.00			
(4) Regulatory quality	0.69	0.78	0.39	1.00		
(5) Rule of law	0.82	0.77	0.58	0.66	1.00	
(6) Voice accountability	0.60	0.47	0.44	0.58	0.52	1.00

Source : authors' calculations

Chapitre 4

DO FDI INFLOWS AND ENERGY PRICE AFFECT THE FOOD IMPORT DEPENDENCY IN DEVELOPING COUNTRIES ?

4.1 Introduction

International trade plays an important role in economic growth and development but it can become problematic if it leads to dependency on imports (Rakotoarisoa *et al.*, 2011), and more problematic if this dependency affects the vulnerability of developing countries (DCs) in terms of food security. An economic growth driven by exports improves balance of payments and generates foreign exchange for food imports (Breisinger *et al.*, 2012). Indeed, after the international food crisis of 2007-2008 caused by higher agricultural and food prices, the vulnerability's issue of DCs to the volatility of international markets is became at the core of the economic debates. In fact, it appeared that this increase has affected the ability of countries to import, which raises several questions about the factors that may boost or reduce the ability to import food. This ability is known as the dependency on food imports and it is measured by the ratio of food import value to total merchandise export value.

DCs need resort to imports because it appears the only solution at short-run to recover the food gap between demand and local production. The food import improves the food

availability (Diaz-Bonilla *et al.*, 2000) but it can be expensive for importers. These countries do not have the same imports'capabilities and preferences on imported products. So the degree of dependency is different between countries ; for example, many Middle East countries spend a large part of their foreign exchange earnings on food imports (Hoering, 2013). The recourse to the international market is relatively expensive when prices are high because the imports are paid in foreign currency.

Currently, the economic environment is characterized by a high attraction of foreign direct investments (FDI) by DCs and a volatility in prices of agricultural, food and energy products in international markets. Indeed, an import challenge of DCs is to have the ability to import food when local food demand is high. In brief, attracting FDI seems to be an important policy to increase the stock of foreign currency to import food. However, the technological development has made the world more dependent on energy use and thus more sensitive to higher energy prices via the high demand. As shown in the economic literature, the international trade is not excluded from the impact of a high energy prices. The production of high varieties of food requires more energy use and intensive fertilizer irrigation which raises the production's cost and the prices of tradable goods (Steinfeld *et al.*, 2006 ; Kamara *et al.*, 2009 ; Chen and Hsu, 2012).

In this context, three relationships are distinguished. The first corresponds to the relationship between FDI and food import dependency, which has not been yet studied. The economic literature only dealt with the relationship between FDI and international trade. This empirical literature is divided between studies that analyze the relationship between trade and FDI outflows, which is usually treated in the case of developed countries, and between trade and FDI inflows in the cases of DCs. Besides some works use time series (Liu *et al.*, 2002 ; Pacheco-López, 2005 ; Wang and Wan, 2008) while others use panel data (Liu *et al.*, 2001 ; Tekin, 2012). From a methodological point of view, all these works use the same econometric techniques such as cointegration and Granger causality.

The second relationship focuses on the link between energy price and food import dependency. The literature is increasingly suggesting that energy prices affect the trade flows inter-country (Chen and Hsu, 2012). Another transmission channel can be mentioned here, the growth of the biofuel industry, which affects the availability of cereals in the international

market and thus may lead to higher food import prices (Hertel and Beckman, 2011).

The third relationship is between FDI and energy price. In previous work, it appears that FDI don't affect the energy demand in DCs (Sadorsky, 2010). For instance in another work, Mielnik and Goldemberg (2002) noticed that more FDI inflows increase, the energy intensity decreases. This is rather beneficial for energy net importing countries that FDI contribute to weaken the local energy demand. But other works have demonstrated the opposite. For example, according to Tang (2009), Malaysia is an energy dependent country where FDI inflows are positively related to electricity consumption and this made the energy importer countries more vulnerable to energy price volatility.

However, our research focuses on the first and the second relationships mentioned above because our objective is to investigate the transmission channels by which the food import dependency is affected and to examine an empirically whether FDI inflows and energy price influence the dependency on food imports in DCs? Indeed, we are aware of the existence of other channels that may affect the food imports dependency. But, based on available data in our hand, we focus on the major factors which have influenced more specifically the food import dependency, since the purpose of our work is to highlight the food security issue.

Despite dependency is an old concept, existing work has not exceeded the descriptive analyzes. Our first contribution is to address the weakness of the existing literature about food import dependency by examining the impact of two important factors. We provide evidence that food security could be influenced by FDI inflows and energy price through international trade. Our second contribution is the use of panel vector autoregressive (VAR) methodology. This choice is justified by the following criteria which are coherent with the aims of our work. i) The panel VAR methodology is useful in the specification of a model with a limited theoretical background; ii) it has the capacity to address the endogeneity problem between variables; iii) it takes into account the country fixed effects and it allows to register the dynamic effects between variables and present the reaction of one variable to a shock of another variable (Grossmann *et al.*, 2014). Finally, this paper distinguishes data by countries' groups (e.g. based on income level). Our results can provide recommendations on trade and economic policy to be followed by DCs to resist to the food insecurity problem.

The remainder of the paper is organized as follows. In the next section, we propose a state of art of food import dependency according to the countries. Section 3 gives theoretical and empirical evidences of the links between food import dependency and its determinants. Section 4 discusses the data used in this paper. Section 5 describes the methodology and section 6 presents the main results of the dynamic relationship between variables and the impulsion response functions. In the last section, we conclude.

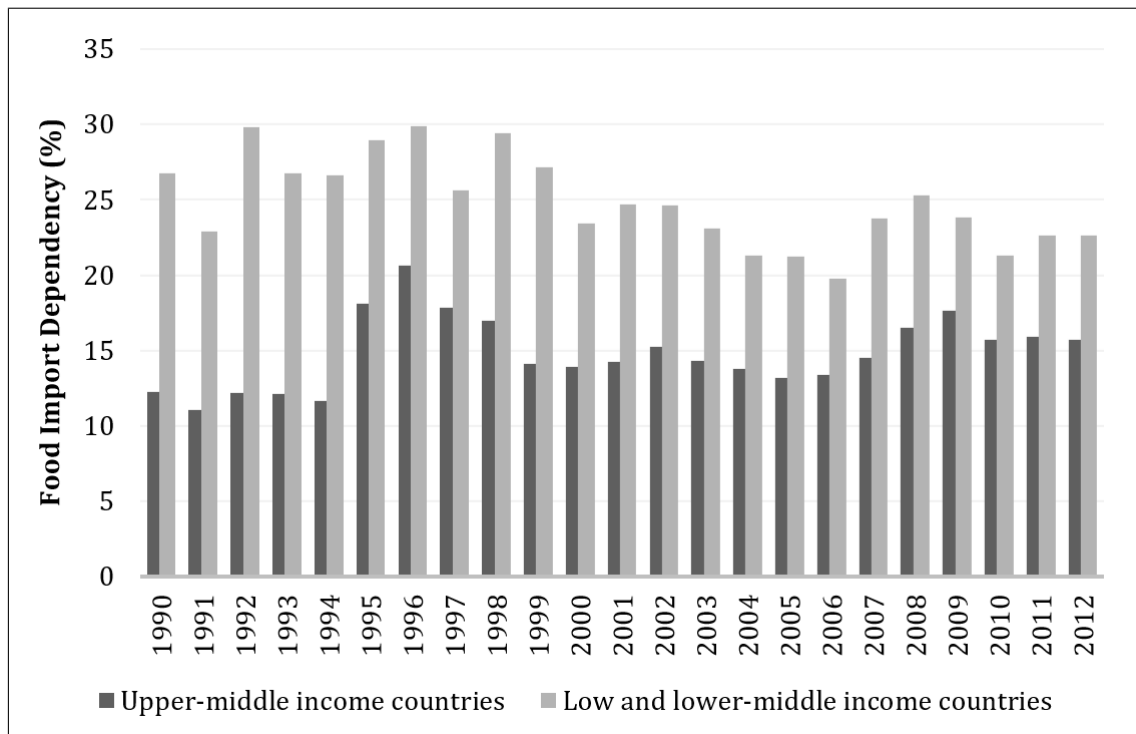
4.2 Food Import Dependency : a state of art

There are several ways to present the concept of food security. Diaz-bonilla *et al.* (2000) have used this concept to analyze the dependency from an international trade point of view. Their objective was the measurement of the ability of countries to finance their food imports out of total export incomes. Many years before, Siamwalla and Valdés (1980) used a similar concept. They used the average of food imports to total export incomes for the period 1965-1977 in DCs. They found only four countries such as Bangladesh, India, Sri Lanka and Egypt with a ratio greater than 15%. Their results confirmed that Asian countries are more dependent than the other regions. By contrast, Farzin (1988) analyzed the food supply situation of some DCs by using a different measurement because his question was the dependence of local food consumption to food imports. Farzin (1988) proposed a descriptive analysis and found that the food aid was a source of dependence in Somalia's economy for the period between 1980 and 1984 : about 51.7% of food consumption comes from import.

A new descriptive data analysis is here proposed and based on 40 developing countries divided in two groups : the group A composed of 23 low and lower middle-income countries, and the group B with 17 upper middle-income countries. Figure 4.1, shows that over the period 1990-2012 the share of food imports over total merchandise exports is higher than 19% and 11% for low and lower middle-income countries and upper middle-income countries, respectively. For the same period, we can see that the low and lower-middle income countries are more dependent on food imports than the upper middle-income countries.

Figures 4.2 and 4.3 show the average of food import dependency based on World Bank's income classification (see Table D1 in Appendix D). According to Figure 4.2, Albania is very dependent to food imports with a ratio of 81%, which explains in part the deficit of its trade

FIGURE 4.1 – The average of food import dependency in 40 developing countries

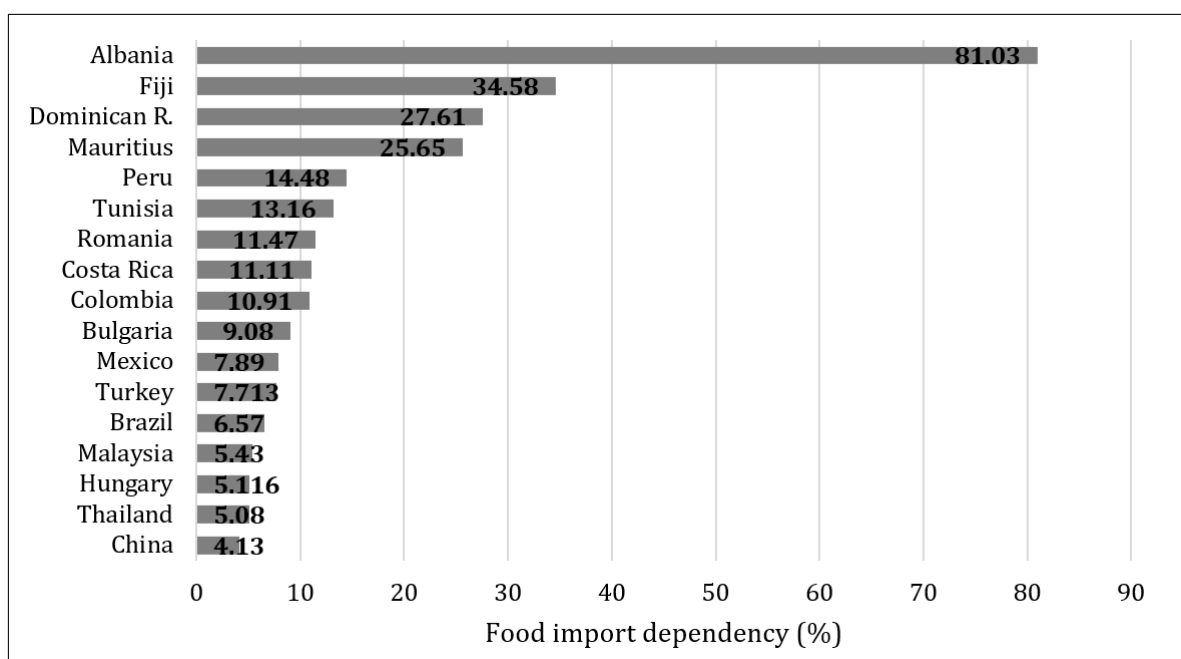


Source : Authors' calculations based on world development indicators (WDI) database

balance. Then, there are three island countries with a ratio higher than 25%. For instance, over the period 1991-2001, Fiji's food production per capita has declined with a rapid rate of rural-urban migration, which explains the higher import dependency (Sharma, 2006). The lowest dependent country to food import is China with a ratio of 4%. This reflects in part the trade policy of China before its accession to the World Trade Organization (WTO) in 2001. It has led a trade policy to encourage exports and limit imports. This policy has allowed China to have the largest foreign-exchange reserve in the world (Liu *et al.*, 2012).

Figure 4.3 confirms the difference in terms of dependency between the two groups of countries. The dependency reached the 20% level in two thirds of the sample. Egypt and India have the highest and the lowest dependency ratio (65% and 6%), respectively. In addition to the weak development, low and lower middle income countries are, with few exceptions, the most vulnerable to food imports. These developing economies are unable to meet local demand and supply of food. For instance, United Republic of Tanzania imposes export bans on key food items to reduce food exports (Liu *et al.*, 2012).

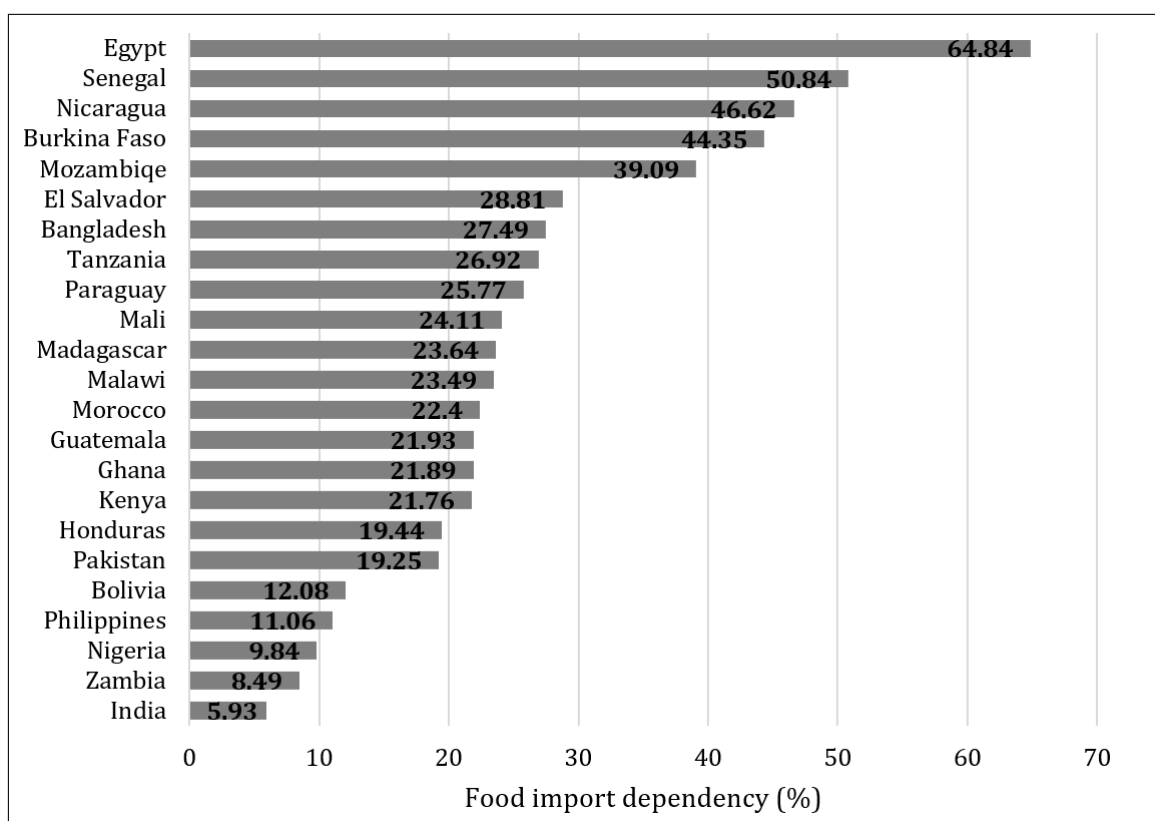
FIGURE 4.2 – The average of food import dependency for the period 1990-2012 in upper middle income countries



Source : Authors' calculations based on world development indicators (WDI) database

In a report on the search of an alternative to food import dependency for Global Policy Forum, Hoering (2013) considered the dependency as a harmful for DCs. The author justified that by the experience of India and South Africa with the United States, where the latter prevented in 1960 to send food to India under the program PL480 because of some political reasons and in 2002, it emphasized to send Genetically Modified maize (GM-maize) as food aid to South Africa. In fact, many factors can affect the vulnerability of the country beyond people and government like market forces on the loose of sovereignty (Hoering, 2013). There is a natural factor like adverse weather conditions which affects the agricultural crops. Some monetary and financial factors also exist like dollar's depreciation, financial crisis, and a higher speculative demand on food commodity futures markets provoked by the low international stock level. In addition, the energy plays an important role in this issue when the high fuel prices increase transportation cost and food production cost, especially for energy importing countries. Finally, a trade policy such as export bans and price controls on cereals may push producers to reduce their supply to the world market and this increases the international prices (Kamara *et al.*, 2009). All these factors are the main determinants of food price rises in international markets and affect the vulnerability of DCs.

FIGURE 4.3 – The average of food import dependency for the period 1990-2012 in low and lower middle income countries



Source : Authors' calculations based on world development indicators (WDI) database

4.3 FDI, energy price and trade : Theoretical and empirical evidences

From a theoretical viewpoint, FDI and trade have a substitution and complementary relationship. In fact, the link between FDI and trade depends in part on the organization of firm activity (Caves, 1982) and to unobserved factors like infrastructure, transport costs, high tariffs to imports, depreciation of host countries' currency, the institutional characteristics, the size and income of host countries (Gastanaga *et al.*, 1998 ; Fontagné, 1999).

When DCs receive FDI, two scenarii may exist. Firstly, FDI may lead to an increase in local production, and thus an increase in local demand of inputs. Such scenario can lead to a decline in imports and a rise in exports (Fontagné, 1999 ; Wang and Wan, 2008). Here, FDI substitute imports and the host country is beneficiary because a decrease of imports contributes to the improvement of trade balance. Nevertheless, firms do not have the same

strategy for delocalization. The second scenario is that FDI may increase the imports of host economy by increasing demand for foreign inputs. As consequence, the trade balance of home country will be improved and that of host country will be deteriorated (Fontagné, 1999). To the extent that FDI generates spillover effects, FDI may enhance the exports of host firms. Aitken et al.(1997) considered that FDI are an export catalyst by facilitating the access of host firms to inputs which are not available on the local market and the access to international market by subcontracting or licensing arrangements and extending cross-border trade.

Based on the existing empirical studies, the relationship between FDI and trade is always controversial. In the case of Mexico during the period between 1970 and 2000, Pacheco-López (2005) found firstly a bidirectional causality between FDI and exports explained by the fact that Multi-National Corporations (MNCs) begin by trading because it is easier and less risky than locate in a foreign country. After acquiring experience and knowledge of the host economy situation, MNCs locate to the host country (Liu *et al.*, 2001) to produce and deliver goods locally and overseas, thus increasing exports. Secondly, they found a bidirectional causality between FDI and imports, which means that the attraction of FDI increases the inputs'imports. (Liu *et al.*(2002) have argued that FDI and exports have bidirectional causality in China by the use of quarterly data from 1981 to 1997. However, they found unidirectional causality from FDI to imports. In other words, FDI inflows can increase imports, while imports do not allow the attraction of FDI. Chinese trade policy encourages the exports more than the imports by adopting an import policy depending on tariff and non-tariff barriers. But it should be noted that this policy is before the accession of China to the WTO. To complete these country studies, Table 4.1 provides results of causal relationships between FDI and trade from two recent empirical works focusing on a broader sample of countries.

While most empirical studies consider the trade by taking the exports and imports separately, Wang and Wan (2008) used the ratio of trade balance expressed by the ratio of imports to exports in value. They examine whether FDI inflows and outflows, real exchange rates, Chinese income and the world income are determinants for the trade balance of China over the period 1979-2007. Their results showed that FDI outflows have no effect on the trade balance. However, FDI inflows contribute to enhance the exports and thus to improve

TABLE 4.1 – Summary of recent empirical studies on the FDI-Trade nexus

Authors	Sample	Causal relationship	Countries
Ahmed <i>et al.</i> (2011)	5 countries from Sub-Saharan 1991–2001	Bidirectional causality	Ghana, Kenya and Nigeria
		Unidirectional causality from FDI to Exports	South Africa
		Unidirectional causality from exports to FDI	Zambia
Tekin (2012)	18 African developing countries 1970-2009	Bidirectional causality	–
		Unidirectional causality from FDI to Exports	Benin, Chad, Haiti, Mauritania, Niger, Togo and Yemen
		Unidirectional causality from exports to FDI	Haiti, Madagascar, Mauritania, Malawi, Rwanda, Senegal and Zambia

the trade balance.

In a nutshell, there are many proofs from trade literature that FDI inflows and trade are linked. For this reason, we believe that FDI inflows may influence food security through the trade channel, specifically the food import dependency. However, let us first examine the role of the energy market. In the context of food security, the energy plays an important role in the supply and demand of food. Several studies have shown that instability in the international energy market affects international trade. The rising price of energy increases the cost of production of goods and services (Turhan *et al.*, 2013). Consequently, the prices of tradable commodities increases. At the same time, the price of energy affects the cost of transport, which promotes trade of cheaper products. In this context, it will be more profitable for an importing country to divert its trade flows to nearest countries and, in this case, gains are benefited by this country because of the minimization of the cost of transport, but a loss of well-being will be supported by it (Bridgman, 2008 ; Kousnetzoff *et al.*, 2008 ; Mirza and Zitouna 2009). However, an increase in energy price can take two forms. An increase may be caused by a negative energy supply shock, leading to a decline in international trade flows, and a positive energy demand shock gives rise to an increase in the international trade flows (Chen and Hsu, 2012). Theoretically, the beneficiaries from these two shocks are the energy-exporter countries and the losers are the energy-importer countries. For this reason, it is important for DCs to have sufficient stock of foreign currency to resist to the spread of food prices in international market.

The literature distinguished a trade and a financial transmission channel by which a rise in energy price affects the current account (Le and Chang, 2013). By focusing on the trade channel, we illustrate the transmission channel by which an increase in oil price affects domestic economy and the international trade flows in Figures 4.4 and 4.5.

We present in Figure 4.4 a host economy, which trades with several other countries named here trading partner countries. An increase in oil price potentially causes inflationary pressure in several countries, leading to raise the import prices in host economy. As a result, the monetary authorities in trading partner countries interfere to curb inflation by increasing the interest rate (see Figure 4.5). This monetary policy leads to a reduction of inflation, a decline in the investment and consumption, and thus to a decrease in imports from the host economy (Korhonen and Ledyeva, 2010 ; Le and Chang, 2013).

FIGURE 4.4 – The effects of oil price on international trade before the intervention of the monetary authority in trading-partner countries

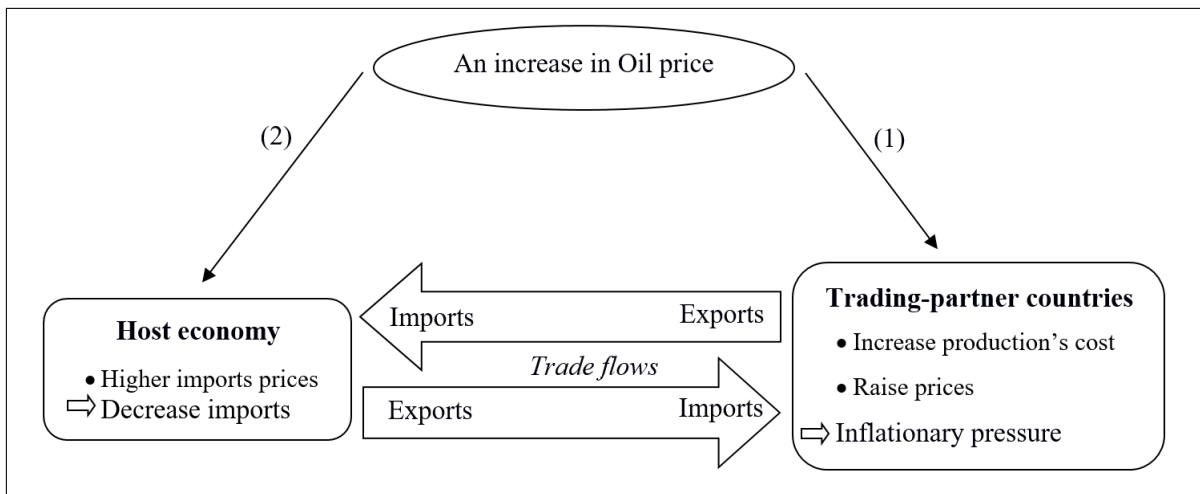
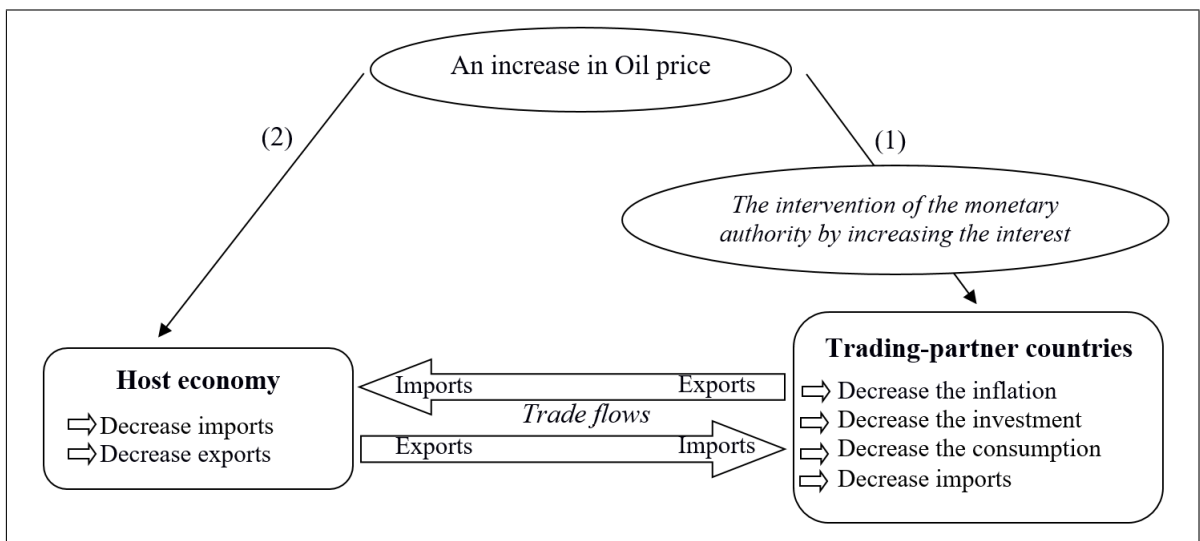


FIGURE 4.5 – The effects of oil price on international trade after the intervention of the monetary authority in trading-partner countries



Secondly, the energy price may play a role due to the fact that food has a competitor which affects its supply. The extraction of biofuel from agricultural products has led to a greater demand for agricultural products for non-food purposes and therefore it contributes to increase their prices (FAO, 2008). Biofuel is extracted from cereals and presents around 5% of the world cereal production (UN, 2009 ; Elbehri *et al.*, 2013). The rise of biofuel production has increased the transmission of energy price volatility into agricultural commodity price variation (Hertel and Beckman, 2011). Starting from the idea that high energy price affects

the trade flows between countries, we examine if the vulnerability of DCs to import food can be affected.

To resume, the impact of FDI inflows on the food import dependency is related to the nature of the relation between FDI and trade, and the increase in energy price seems to be a brake to international trade. So we expect to find at minimum a response of food import dependency to a shock on FDI inflows and energy price.

4.4 Data and unit root test

This paper focuses on the study of 40 developing countries for the period between 1990 and 2012. FDI inflows data as a share of GDP are collected from the World Development Indicators (WDI) database of the World Bank. Dependency on food imports is here measured by the ratio of food imports over total merchandise exports ; it is collected from the WDI and we named it FMX¹ :

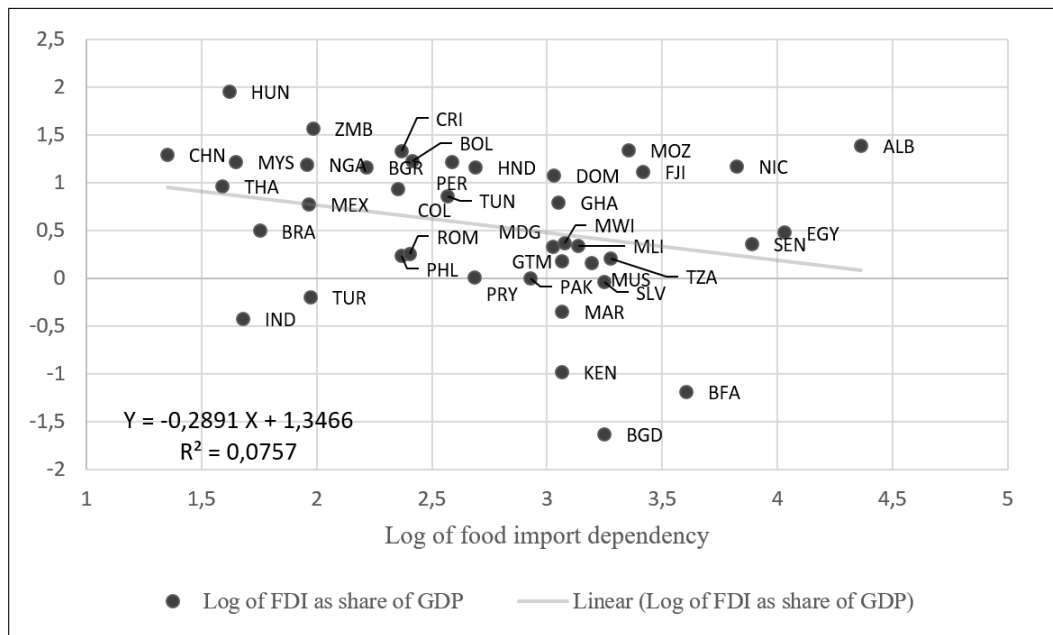
$$FMX = \frac{\text{Value of food imports}}{\text{Value of total merchandise exports}} \quad (1)$$

For the ennergy price, we encountered the same constraints like many authors : the unavailability of energy prices data for DCs. So, we follow Asafu-Adjaye (2000), Mahadevan and Asafu-Adjaye (2007), Odhiambo (2010) and Doytch and Narayan (2016) and we proxied the energy price by the consumer price index (CPI). Data comes from WDI database. Our choice is justified by the fact that residents and industries in many countries don't pay the same price of energy because it is subsidized by government (Mahadevan and Asafu-Adjaye, 2007). In addition, the CPI can captures the inflationary pressure of high oil price in international market. By testing the correlation between the oil price index at internatinal market and the CPI for each country, we found a very hight degree of linear dependence (around 0.81). In final, our three variables are used in the natural logarithm form.²

1. The same indicator is used by the FAO to measure the stability dimension of food security.

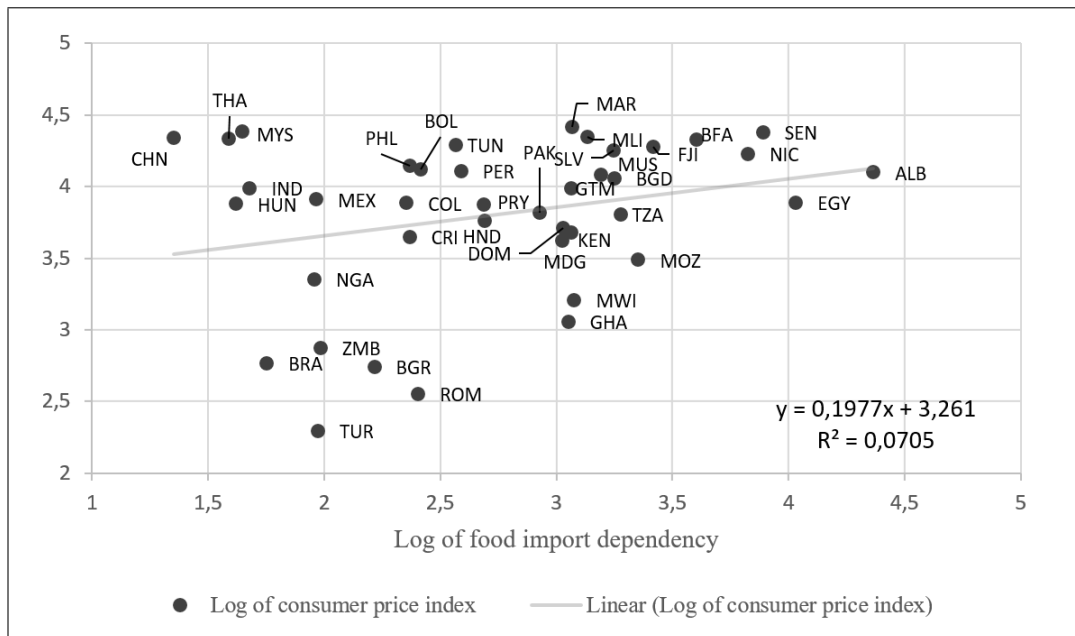
2. A correlation analysis is performed between all variables (Table D2 in the Appendix). We found a low correlation between variables.

FIGURE 4.6 – Linear correlation between FDI inflows (% of GDP) and food imports dependency ratio (FMX)



Source : Authors' calculations based on WDI

FIGURE 4.7 – Linear correlation between the proxy of energy price index and food import dependency ratio (FMX)



Source : Authors' calculations based on WDI

The relationship between the natural logarithm of FDI inflows and energy price with food import dependency (FMX) can be observed from Figures 4.6 and 4.7, which represent

the averaged variables from 1990 to 2012 (See Table D1 in the appendix for the list of countries). FDI seem to be negatively associated with FMX, but this is not the case for energy price where the correlation seems to be positive (Figure 4.7). The linear correlation suggests that FDI can be a brake for the food import dependency, but the energy price can be an amplifier.

In fact, it's not possible to confirm this intuition with just a linear correlation test between variables. The dynamic relationship between the variables is not taken into account and therefore these relations are currently lacking additional information. So in the next section we deepen the analysis of such relationships. In a first step, we apply a panel unit root test to our variables. We use the Cross-sectionally Augmented Dickey-Fuller (CADF)³ test of Pesaran (2007) to take into account the correlation across sections in series. The optimal lag length is selected by Schwarz's criteria. Null hypothesis assumes that all series are non-stationary. The results of Pesaran's CADF unit root test are reported in Table 4.2. We proceed by testing the unit root at level with constant and next with constant and trend. The results show that in most specifications, FDI and CPI are stationary at level and only FMX seems to be stationary at first difference.

TABLE 4.2 – Results of CADF Unit root test

variables	At level				At first difference	
	lags	with constant S. Z[t-bar]	lags	with constant and trend S. Z[t-bar]	lags	with constant S. Z[t-bar]
All sample						
FMX	1	-0.562	1	0.936	1	-8.193***
FDI	1	-4.325***	1	-1.534*	1	-10.786***
CPI	1	-4.194***	2	-4.077***	1	-8.831***
Group A						
FMX	1	-0.757	1	1.425	1	-5.206***
FDI	1	-2.645***	1	-0.467	1	-8.255***
CPI	1	-2.624***	1	1.265	2	-3.537***
Group B						
FMX	1	-1.211	1	-0.151	1	-5.663***
FDI	1	-3.216***	1	-1.584*	1	-7.177***
CPI	1	-1.467*	1	-2.203**	1	-3.921***

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

3. Our test of unit root is implemented in Stata 13 using the procedure described by Lewandowski (2006). It enables to take into account the possible cross-sectional dependence.

4.5 Methodology

In the literature many econometric studies have used the VAR (Vector Autoregressive), the VEC (Vector Error Correction) and Autoregressive Distributed Lag models. Some models are used in time series framework while others are used in panel framework. According to the literature and to our CADF test used in the previous section, the appropriate technic is a panel vector auto regressive (PVAR)⁴ model proposed by Love and Zicchino (2006). The first-order VAR model is given by :

$$Z_{it} = \Gamma(L) Z_{it-1} + f_i + d_t + e_{it} \quad (2)$$

where Z_{it} is the vector of dependent variables (Δ FMX, CPI, FDI); Z_{it-1} is a vector of lagged dependent variables and $\Gamma(L)$ is a matrix polynomial in the lag operator⁵; f_i is a vector of country fixed effects; d_t are time dummies; and e_{it} is a vector of idiosyncratic errors.

The specificity of this model is that it allows for individual heterogeneity in the levels of variables by introducing fixed effects. However, in the presence of lagged dependent variables, the estimation will be biased due to the correlation with country fixed effects. To avoid this issue, we follow Love and Zicchino (2006) by applying the forward mean-differencing⁶ procedure. The objective is to transform all variables of the model in deviations from forward means to remove the fixed effects. A detailed explanation for this procedure is given by Boubtane *et al.* (2013).

Let z_{it}^m and e_{it}^m denote a variable and an error term, respectively in two vectors :

$$\begin{aligned} Z_{it} &= (z_{it}^1, z_{it}^2, \dots, z_{it}^M)' \\ &\text{and} \\ e_{it} &= (e_{it}^1, e_{it}^2, \dots, e_{it}^M)' \end{aligned}$$

The means obtained from the future values of z_{it}^m and e_{it}^m are equal to

4. A Stata program, built by Love and Zicchino (2006) allows the estimation of Panel VAR model and the calculation of impulse-response functions. In this paper we use an improved version (Abrigo and Love, 2015).

5. The matrix polynomial can be written as $\Gamma(L) = \sum_{n=1}^p \Gamma_n L^n$.

6. It is also known by the Helmert's procedure (see Arellano and Bover, 1995).

$$\bar{z}_{it}^m = \sum_{s=t+1}^{T_i} \frac{z_{is}^m}{(T_i - 1)} \quad (3)$$

and

$$\bar{e}_{it}^m = \sum_{s=t+1}^{T_i} \frac{e_{is}^m}{(T_i - 1)} \quad (4)$$

Where T_i is the last period of available data for a given country series.

The transformed variable and error term can be written as :

$$\tilde{z}_{it}^m = \delta_{it} (z_{it}^m - \bar{z}_{it}^m) \quad (5)$$

and

$$\tilde{e}_{it}^m = \delta_{it} (e_{it}^m - \bar{e}_{it}^m) \quad (6)$$

where $\delta_{it} = \sqrt{\frac{T_i - t}{T_i - t + 1}}$

However, the last year of data cannot be calculated, because there are no future values for the construction of the forward means. The transformed model becomes :

$$\tilde{Z}_{it} = \Gamma(L) \tilde{Z}_{it} + \tilde{e}_{it} \quad (7)$$

where $\tilde{Z}_{it} = (\tilde{z}_{it}^1, \tilde{z}_{it}^2, \dots, \tilde{z}_{it}^M)'$ and $\tilde{e}_{it} = (\tilde{e}_{it}^1, \tilde{e}_{it}^2, \dots, \tilde{e}_{it}^M)'$

This transformation is in fact an orthogonal deviation, each observation being expressed as a deviation from average future observations. This technique allows the use of lagged values of regressors as instruments and we estimate the transformed model (7) as a system of three equations by the Generalized Method of Moments (GMM). Nevertheless, our goal is to determine how food import dependency responds to changes in FDI inflows and energy price, so we will only focus on the equation where the ratio of food import dependency is the dependent variable.

In a next step, we compute the impulse-response functions which describe the reaction of one variable to the innovations in another variable in the system. So we identify the orthogonal shocks of independent variables by using the Cholesky decomposition (see Love and Zicchino, 2006).

4.6 Empirical results

4.6.1 Panel VAR and Granger causality test

Following the methodology of Love and Zicchino (2006), the results are presented in Tables 4.3, 4.4 and 4.5 for bivariate and trivariate panel VAR models. The choice of the best lag length is important in any VAR model. The check of lag order avoids us the loss of degrees of freedom and over-parameterization. According to the Schwartz information criteria the appropriate lag is here one period.

In Table 4.3, we have estimated first the panel of 40 countries in a bivariate and trivariate panel VAR model. For the three models, we have not found any significant effect from FDI and CPI to FMX.

TABLE 4.3 – Panel VAR's results for 40 developing countries

	Dependent variables		
	(1)	(2)	(3)
Independent variables	Δ FMX	Δ FMX	Δ FMX
Δ FMXt-1	-0.154*** (-3.27)	-0.161 (-3.36)	-0.162*** (-3.38)
FDI t-1	0.19 (1.05)	–	0.017 (1.23)
CPI t-1	–	0.029 (1.12)	0.012 (0.4)

Heteroskedasticity adjusted z-statistics are in parentheses.

* significant at the 10 percent level.

** significant at the 5 percent level.

*** significant at the 1 percent level.

Second, we estimated the panel VAR model for only low and lower middle-income countries (See Table 4.4). In model (1), results show that FDI inflows have a positive and significant effect at the level of 5%. In model (2), CPI has a negative but not statistically significant effect. Model (3) shows the same results than in the previous models : FDI have a positive and significant effect and CPI keep the negative and no significant coefficient. These results show that FDI increase the dependency of low and lower income countries to food import and the energy price doesn't have any effect.

TABLE 4.4 – Panel VAR's results for Group A (low and lower middle income countries)

Independent variables	Dependent variables		
	(1)	(2)	(3)
$\Delta\text{FMX t-1}$	ΔFMX -0.188*** (-3.08)	ΔFMX -0.194*** (-3.16)	ΔFMX -0.201*** (-3.27)
FDI t-1	0.044** (2.25)	–	0.034** (2.16)
CPI t-1	–	-0.005 (-0.19)	-0.042 (-1.18)

Heteroskedasticity adjusted z-statistics are in parentheses.

* significant at the 10 percent level.

** significant at the 5 percent level.

*** significant at the 1 percent level.

Third, we focus on the upper middle-income countries. The results are different from the previous ones. Only CPI affects positively FMX (see Table 4.5). This result confirms our intuition that energy price has an adverse effect on international trade and specifically food import dependency.

TABLE 4.5 – Panel VAR's results for Group B (upper middle income countries)

Independent variables	Dependent variables		
	(1)	(2)	(3)
$\Delta\text{FMX t-1}$	ΔFMX -0.063 (-0.99)	ΔFMX -0.117 (-1.22)	ΔFMX -0.125 (-1.15)
FDI t-1	0.057 (-1.17)	–	-0.021 (-0.61)
CPI t-1	–	0.0862** (2.06)	0.107* (1.81)

Heteroskedasticity adjusted z-statistics are in parentheses.

* significant at the 10 percent level.

** significant at the 5 percent level.

*** significant at the 1 percent level.

Then, to test the causality between variables, we have applied a bivariate and trivariate Granger causality test and results are reported in Table 4.6. The unidirectional causality is found running from FDI to FMX only on group A and from CPI to FMX only on group B.

TABLE 4.6 – Bivariate and trivariate Granger causality test

	All sample			Group A			Group B		
	Δ FMX			Δ FMX			Δ FMX		
FDI	1.095	–	1.501	5.042**	–	4.667**	1.360	–	0.371
CPI	–	1.254	0.161	–	0.035	1.402	–	4.249**	3.291*

* significant at the 10 percent level.

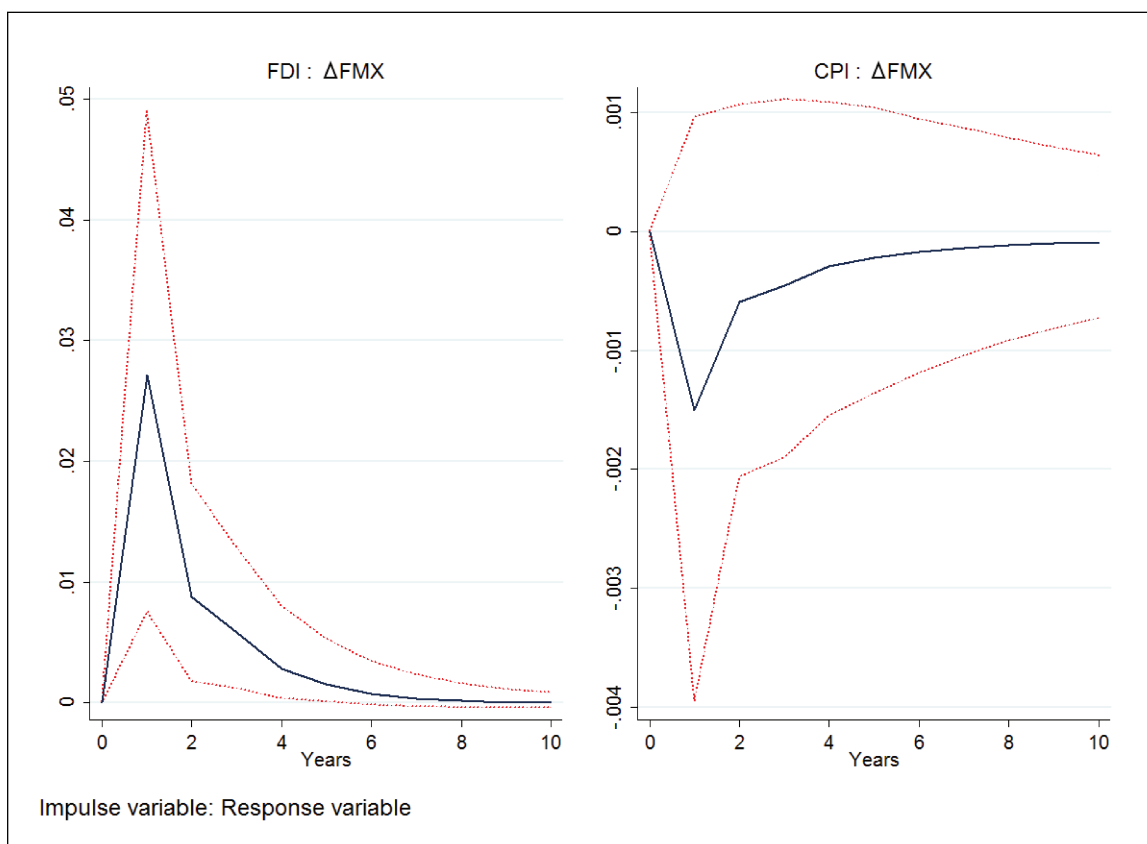
** significant at the 5 percent level.

*** significant at the 1 percent level.

4.6.2 Impulsion functions results

Figures 4.8 and 4.9 present the impulse-response functions with a standard error of 95% confidence; errors are generated by Monte-Carlo with 1000 replications. Figure 4.8 reports the impulse responses for group A, while Figure 4.9 reports the impulse responses for group B. The objective here is to check the expected reaction in the future of the capacity of importing food in case of shocks.

FIGURE 4.8 – Impulse responses of FMX to shocks in FDI and CPI for group A

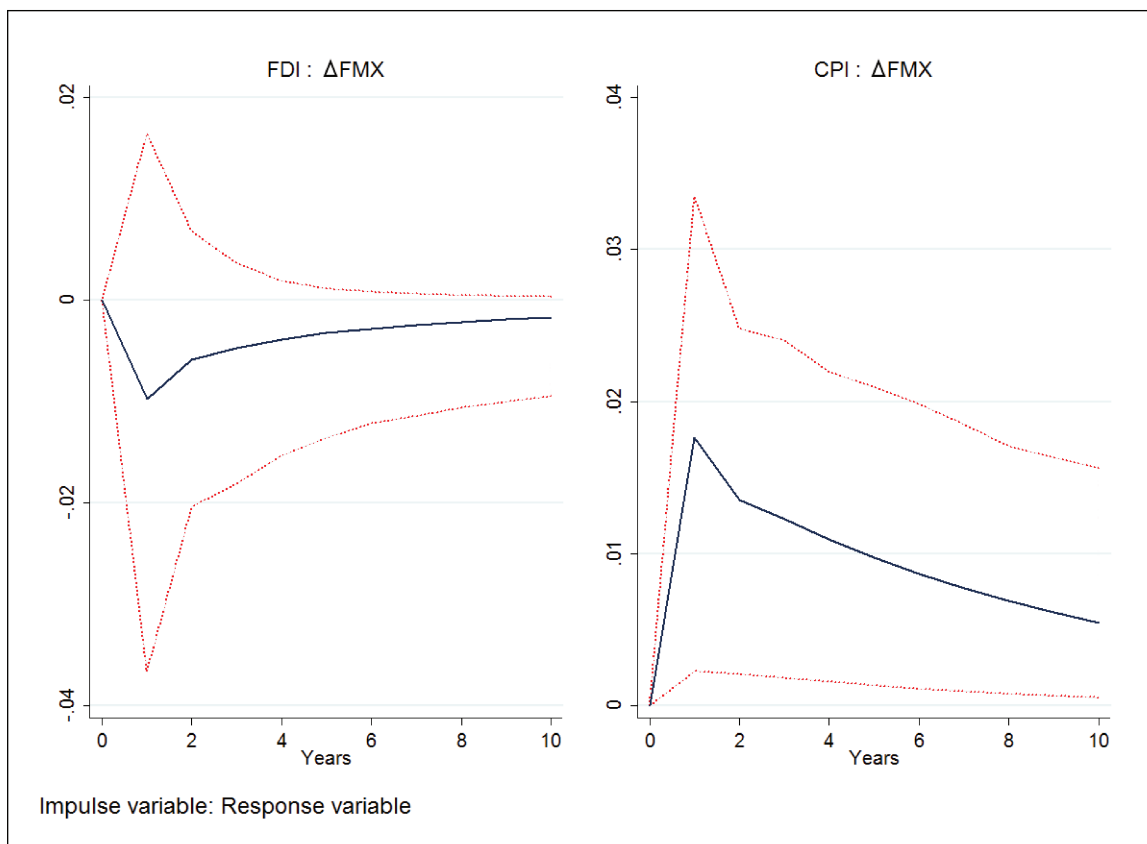


Note : The errors are 5% on each side generated by Monte-Carlo simulation with 1000 reps.

In Group A, we found that FMX responds positively to the FDI inflows increase with a peak in the first year before a decrease. After six years, the response becomes quite weak, close to zero all the time (see Figure 4.8). In contrast, the respond of FMX to the price impulse is completely the reverse for the same period. The influence magnitude of one standard deviation from CPI on FMX first decreases. Low and lower middle-income countries have a positive food import dependency's response to FDI inflows ; the FDI inflows are probably not able to boost exports.

Let move to the analysis of group B. In Figure 4.9, we observe that FMX has a negative short-term response to a shock in FDI, and a positive short-term response to a shock in CPI. It seems that upper middle-income countries are more vulnerable to shocks in prices than in FDI inflows. Moreover, the response is the opposite than that observed for countries of group A. This means, therefore, that low and lower middle-income countries are more sensitive to shocks in FDI inflows.

FIGURE 4.9 – Impulse response of FMX to shocks in FDI and CPI for group B



Note : The errors are 5% on each side generated by Monte-Carlo simulation with 1000 reps.

4.7 Discussion and Conclusion

In this paper, the causal relationship between FDI inflows, energy price and food import dependency is examined for 40 countries using a panel VAR model. We split the sample on two groups, the first corresponds to the developing countries with low income and lower middle income and the second is composed of the developing countries with upper middle income, over the period 1990-2012.

Our paper reveals some interesting findings regarding the food stability in developing countries. We provide empirical evidence of the causal links from FDI inflows and energy price to food import dependency. However, it seems that FDI inflows increase dependency in low and lower middle-income countries. Otherwise, FDI inflows are unable to improve the capacity of these countries to import food. This result may be explained by the fact that these countries haven't the ability to absorb the all benefits of FDI and they are more vulnerable to access international food markets. On the other hand, a rise in prices increases food import dependency in upper middle-income countries and therefore their ability to import food deteriorates.

Our paper has highlighted the transmission mechanism by which the vulnerability of developing countries to import food responds to a FDI or an energy price shock. We found theoretical evidence for the existence of indirect links about the direction of the response of food import dependency. In addition, our research reveals that food import dependency response depends on the income level of the country. The impulse response function results show that the responsiveness of the food import dependency is positive in low and lower-middle income countries in case of a FDI shock and is positive in upper middle-income countries following a price shock.

This research has some emerging policy implications. It is strategically important for low and lower income countries to change their trade policy, specifically in the food sector. Firstly, these countries must seek to attract export oriented FDI. Secondly, these countries must invest on their ability in absorbing the FDI's spillovers because it can be a way to acquire skills and technology, to innovate new marketing strategies and managerial practices, to find new methods and channels of distribution and thus to access international markets.

For upper middle-income countries, we recommend the use of renewable energy to reduce their access to international energy market.

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Annex D

FIGURE D.1 – The trend of food import dependency by country for the period 1990-2012



Source : Authors' calculations based on WDI database.

TABLE D.1 – Countries list

Low-income economies		Lower middle income economies		Upper middle income economies	
GNI per capita less than 1 045\$	Code	GNI per capita of more than 1 045\$ but less than 4 125\$	Code	GNI per capita of more than 4 125\$ but less than 12 746\$	Code
Bangladesh	BGD	Bolivia	BOL	Albania	ALB
Burkina Faso	BFA	Egypt	EGY	Brazil	BRA
Kenya	KEN	El Salvador	SLV	Bulgaria	BGR
Madagascar	MDG	Ghana	GHA	China	CHN
Malawi	MWI	Guatemala	GTM	Colombia	COL
Mali	MLI	Honduras	HND	Costa Rica	CRI
Mozambique	MOZ	India	IND	Dominican Republic	DOM
Tanzania	TZA	Morocco	MAR	Fiji	FJI
		Nicaragua	NIC	Hungary	HUN
		Nigeria	NGA	Malaysia	MYS
		Pakistan	PAK	Mauritius	MUS
		Paraguay	PRY	Mexico	MEX
		Philippines	PHL	Peru	PER
		Senegal	SEN	Romania	ROM
		Zambia	ZMB	Thailand	THA
				Tunisia	TUN
				Turkey	TUR

Notes : The income classification is from the World Bank. According to the classification of UNCTAD, 22 countries in our sample are net food-importers and only three countries are exporters of petroleum. Result is not reported for these two classifications because we have not found a significant one.

TABLE D.2 – Correlation test between all variables

	<i>FMX</i>	<i>FDI</i>	<i>CPI</i>
<i>FMX</i>	1		
<i>FDI</i>	-0.1395	1	
<i>CPI</i>	0.0507	0.3606	1

Source : Author's calculations.

CONCLUSION GÉNÉRALE

Cette thèse propose une analyse économique des liens existants entre les flux d'IDE et la sécurité alimentaire. Elle s'articule autour de quatre chapitres dont un premier est descriptif et trois chapitres proposent des investigations empiriques. Dans ces derniers, nous avons traité les quatre dimensions de la sécurité alimentaire reconnues par la FAO. A partir d'un panel d'une cinquantaine de pays en développement sur une période qui varie entre 1990 et 2012, notre recherche a éclairé des questions qui ne sont pas toujours bien étudiées sur le plan empirique. Nous avons mis en exergue l'effet des flux de l'IDE sur la sécurité alimentaire en tenant compte de trois facteurs importants, la production agricole, la qualité institutionnelle et le commerce international. Pour répondre à notre problématique, il a été nécessaire d'utiliser des méthodes économétriques différentes. Notre méthodologie a consisté à chercher une mesure de sécurité alimentaire qui nous permette de prendre en compte plus qu'une dimension de la sécurité alimentaire. Dans les deuxième et troisième chapitres, nous avons analysé la relation entre cette mesure et d'autres variables macroéconomiques. Notre intérêt s'est alors porté sur les pays pour lesquels des données d'IDE désagrégées sont disponibles et couvrent une période suffisamment étendue. Enfin, nous nous sommes intéressés à la dimension de la stabilité où nous avons focalisé la question de recherche sur la capacité des PED à importer leurs aliments.

Notons que notre recherche a été menée en croisant parfois deux champs de recherche différents mais très proches : l'économie et la sociologie. En fait, la sécurité alimentaire est un enjeu économique et sociétal. Elle est qualifiée par primordial à cause de son importance pour l'existence humaine. Toutefois, l'économie d'aujourd'hui se caractérise par l'ouverture commerciale et par une mobilité de capitaux importante à l'échelle internationale. Le poids des PED dans les flux d'IDE internationaux s'est accru et ils voient les flux de capitaux affluer. Ceux-ci se caractérisent par leur nature monétaire (ils présentent une source de financement et d'accumulation de capital) et aussi par leur nature de transmission de

connaissance et de technologie grâce à l'implantation des entreprises étrangères.

La littérature économique propose une analyse des impacts des flux d'IDE sur la croissance économique. L'évaluation est jugée ambiguë car l'effet peut être positif et/ou négatif. Les études réalisées dans ce contexte ont utilisé des données agrégées pour les flux d'IDE. A la recherche du profit, les investisseurs étrangers ciblent tous les secteurs d'activité économiques et ainsi les flux d'IDE influencent de différentes manières l'économie d'accueil. Autrement dit, l'effet ne se limite pas à un seul sens, positif ou négatif.

Le chapitre 1 analyse, dans un premier temps, la situation alimentaire des PED selon les quatre dimensions de la sécurité alimentaire et dans un second temps il décrit la répartition géographique des flux d'IDE dans le monde. Le chapitre 2 démontre le rôle important de la production agricole. Les IDE du secteur agricole contribuent à l'amélioration de la sécurité alimentaire à travers la production agricole qui est la principale source d'alimentation. L'accroissement de la production agricole est essentiel pour la sécurité alimentaire mais le plus important est de rendre cette production accessible dans de bonnes conditions. C'est ici que le rôle de l'institution locale apparaît important, ce que nous analysons dans le chapitre 3. Lorsque l'institution est responsable et consciente de la nécessité de mettre en œuvre des politiques économiques en faveur de la sécurité alimentaire, elle va fournir l'infrastructure nécessaire pour atteindre cet objectif. Ainsi, la capacité d'absorber l'IDE s'améliore. Nos résultats suggèrent qu'une plus grande qualité institutionnelle favorise l'efficacité des IDE dans les secteurs primaires et secondaires. Les pauvres sont les plus touchés par le manque d'accès et les mauvaises conditions d'utilisation de la nourriture. Cela est expliqué en majeure partie par leur faible revenu suite à la mauvaise répartition de la richesse envers cette catégorie de ménages. L'accroissement de revenu doit obligatoirement s'accompagner d'une réduction d'inégalité de revenu, cette dernière ferait le contrepois aux efforts visant à améliorer la situation alimentaire.

Enfin, nous nous sommes intéressés à la relation dynamique de l'aspect commercial de la sécurité alimentaire avec les flux entrants d'IDE et le prix de l'énergie, dans le chapitre 4. A ce stade, notre objectif était d'examiner la capacité d'un pays à importer ces produits alimentaires et d'évaluer comment cette capacité fluctue en présence des flux entrants d'IDE et de la hausse du prix de l'énergie. Nos résultats relatifs à la vulnérabilité

des PED en termes d'importations alimentaires révèlent que le niveau de développement du pays est très important dans la compréhension de la dépendance alimentaire. En effet, nos résultats ont montré que les pays à revenu faible et moyen inférieur sont les plus vulnérables face à un choc de flux entrants d'IDE. En d'autres termes, les flux entrants d'IDE ne sont pas en mesure d'augmenter l'exportation et ainsi le stock de devises des pays d'accueil. Par conséquent, la capacité de ces PED à importer leur alimentation se dégrade. Les pays qui appartiennent à la catégorie de revenu intermédiaire supérieur sont davantage concernés par la hausse du prix de l'énergie que par les flux d'IDE. Nos résultats ont montré qu'une hausse de prix de l'énergie a accru la dépendance en importations alimentaires.

Dans cette thèse, nous avons trouvé des preuves que la sécurité alimentaire est liée à la mondialisation. Toutefois, cette relation n'est bénéfique pour les PED qu'en présence d'un certain nombre de conditions économiques qui doivent être réunies. Il peut y avoir deux types d'effets sur l'économie d'accueil, le premier est direct en terme d'accumulation de capital et c'est une bonne raison pour attirer les IDE, et le deuxième est un effet indirect sous forme de «*spillovers*», et dans ce cas les pays doivent être très vigilants aux effets pervers. Un bon ciblage d'IDE entrants présenterait une bonne politique pour les pays d'accueil pour exploiter au mieux les «*spillovers*» qui touchent leur sécurité alimentaire. Ces effets de contagion seraient ainsi en mesure d'absorber favorablement les capitaux étrangers et de concevoir des politiques économiques susceptibles d'altérer les effets d'IDE afin d'avoir les «*spillovers*» désirés.

Pour soutenir la prospérité économique et améliorer la sécurité alimentaire à long terme, nous recommandons d'abord d'investir dans l'amélioration de la qualité institutionnelle et la redistribution des revenus. Les institutions économique et politique doivent impérativement être en mesure de former une économie capable d'exploiter les bénéfices de l'IDE. Les décideurs économiques doivent être en mesure de mettre en œuvre des stratégies pour attirer l'IDE qui permet de générer des bénéfices en devises.

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