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FOUR ESSAYS ON FISCAL POLICY AND PUBLIC SPENDING MANAGEMENT

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par

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EXECUTIVE SUMMARY

This thesis examines critical questions related to the interaction between fiscal policy, financing sources and public spending management. While the chapter 2 reviews the macroeconomic impacts of fiscal consolidations on developed and emerging countries, chapter 3 investigates the contributions of fiscal adjustments to efficiency gains. Chapter 4 assesses the efficiency of government investment in WAEMU countries and unveils the effects of the financing sources on public spending management. Finally, chapter 5 estimates fiscal multipliers for African countries using new structural macroeconomic models. These four chapters highlight interesting results. In chapter 2, the findings provide evidence of the contraction of public investment more than that of government consumption. This composition effect is stronger during high debt distress, low phase of business cycle and following debt and stock market crises. Chapter 3 shows that the implementation of fiscal consolidations induce significant improvement in public investment efficiency. Robust to a wide range of alternative specifications, huge public investment efficiency gains arise during economic slack, with a policy mix and high perceived sovereign default risk as well as with the support of IMF programs. Focusing on WAEMU countries, chapter 4 shows that countries in this zone are less efficient than that of African and Asian peer countries. In addition, the chapter finds that external (domestic) debt positively and significantly (not significant enough) impacts the probability to have good public management due to conditionality. This indicates that there is room for domestic and/or regional debt to boost efficiency if domestic debt become more competitive. Chapter 5 suggests that South Africa multipliers are positive and small using the New Keynesian DSGE model. The chapter also finds a crowding-out effect between government purchases and investment and private consumption.

RESUME EXECUTIF

Cette thèse examine les questions liées à l'interaction entre la politique budgétaire, les sources de financement et la gestion des dépenses publiques. Le chapitre 2 analyse les impacts macroéconomiques des consolidations budgétaires sur les pays développés et émergents, le chapitre 3, quant à lui, montre les effets des ajustements budgétaires sur l'efficience des investissements publics. Le chapitre 4 évalue l'efficience des investissements publics dans les pays de l'UEMOA et dévoile l'importance des sources de financement dans la gestion des investissements publics. Enfin, le chapitre 5 estime les multiplicateurs budgétaires pour les pays africains en utilisant de nouveaux modèles macroéconomiques structurels. Ces quatre chapitres mettent en évidence des résultats intéressants. Au chapitre 2, les résultats fournissent des preuves d'une contraction de l'investissement public plus prononcée que celle de la consommation publique durant les périodes de consolidations budgétaires. Cet effet de composition est plus marqué en cas de surendettement, de récessions ou de crises boursière et de la dette. Le chapitre 3 montre que la mise en œuvre des consolidations budgétaires induit une amélioration significative de l'efficience des investissements publics. Robustes à un large éventail de spécifications alternatives, d'énormes gains d'efficience se produisent si les consolidations budgétaires surviennent lors du ralentissement économique, accompagnées par un policy-mix, avec un risque de défaut souverain perçu élevé, ainsi qu'avec le soutien des programmes du Fonds Monétaire International (FMI). En se focalisant sur les pays de l'UEMOA, le chapitre 4 montre que les pays de cette zone sont moins efficients que ceux des pays pairs africains et asiatiques. En outre, le chapitre constate que la dette extérieure (intérieure) a un impact positif et significatif (pas assez significatif) sur la probabilité d'avoir une bonne gestion publique en raison de la conditionnalité. Cela indique que la dette intérieure et / ou régionale peut accroître l'efficience des investissements si elle devient plus compétitive. Le chapitre 5 montre que le multiplicateur des dépenses publics de l'Afrique du Sud est positif et faible en utilisant le modèle DSGE suivant le néo-Keynésianisme. Le chapitre trouve également un effet d'éviction des dépenses publiques sur l'investissement et la consommation privée.

CHAPITRE 2 : LES EFFETS DE LA CONSOLIDATION BUDGETAIRE SUR LA COMPOSITION DES DEPENSES PUBLIQUES

Pour lutter contre les effets néfastes de la récente crise financière, de nombreux gouvernements ont adopté des politiques budgétaires de relance. Ces politiques expansionnistes, avec pour objectif de stimuler la croissance et réduire le chômage, ont entrainé des accroissements considérables du déficit et de la dette publique. L'ampleur et l'imminence de l'impact négatif de ces accroissements sur la soutenabilité des finances publiques ont conduit les Etats à mettre en œuvre des programmes d'assainissement budgétaire. Il existe une littérature croissante et abondante sur les consolidations budgétaires. Plusieurs questions importantes liées aux effets des ajustements budgétaires ont été exploré. Ces sujets touchent (i) à l'importance de la taille des épisodes de consolidation (Giavazzi et Pagano, 1995 ; Ardagna, 2004); (ii) à leur persistance (Drazen, 1990); (iii) au type de mesure, soit basé sur des variables observées telles que le solde primaire corrigé des variations conjoncturelles ou sur l'approche narrative (Alesina et Ardagna, 1998; Alesina et Ardagna, 2010; Cotis et al, 2004; Guajardo et al, 2014) et (iv) au choix de la variable d'ajustement, à savoir les dépenses ou les taxes.
Sur ce dernier point, Afonso et Jalles (2012); Alesina et Ardagna (1998); Alesina et Perotti (1995); McDermott et Wescott (1996) entre autres, ont constaté que la réussite de l'exercice de consolidations reposent principalement sur des réductions de dépenses plutôt que sur des augmentations d'impôts. De plus, Alesina et al. (2015, 2018); Heylen et al. (2013) concluent que les consolidations budgétaires entraînées par des réductions de dépenses sont plus susceptibles d'apporter de la croissance et de réduire les déficits / dettes que celles induites par les hausses d'impôt.
Par conséquent, en se concentrant sur les dépenses publiques, plusieurs contributions ont étudié la composante des dépenses publiques qui devraient être réduite dans le cadre de l'assainissement budgétaire. D'une part, les gouvernements pourraient réduire l'investissement public, ce qui est moins efficace pour réduire la dette (Alesina et Perotti, 1995) mais politiquement plus acceptable. Cependant, la baisse de l'investissement public peut nuire à la productivité globale (Aschauer, 1989) à la croissance économique (Abiad et al., 2016), et

au bien-être (Heijdra et Meijdam, 2002), au point où, compte tenu de de la conjoncture économique mondiale actuelle, le FMI (2014, 2015) et la Commission Européenne (Plan Juncker 2014) plaident pour de grands investissements publics dans les infrastructures pour soutenir la reprise mondiale après la crise. D'autre part, les gouvernements pourraient réduire les dépenses courantes, qui sont plus efficaces pour réduire le déficit mais peuvent affecter la probabilité de réélection des gouvernements (Roubini et Sachs, 1989), et accroître les inégalités et la pauvreté (Agnello et Sousa, 2014).

Au regard de ce qui précède, l'objectif de ce chapitre est d'analyser l'effet de la consolidation budgétaire sur la composition des dépenses publiques. Malgré son importance particulière, compte tenu des avantages et des coûts associés à la réduction de chaque type de dépenses publiques, cette question reste assez inexplorée, à l'exception notable de Castro (2017). Par rapport à Castro (2017), nous nous appuyons sur la nouvelle mesure de contractions budgétaires d' Alesina et Ardagna (2013) qui tient compte de l'ampleur et de la persistance de l'ajustement (au lieu d'une variable muette comme mesure des consolidations budgétaires, voire De Haan et al. (1996)). De plus, nous nous concentrons spécifiquement sur le ratio entre les dépenses courantes et celles d'investissement, contrairement à Castro (2017) qui se focalise sur les différentes dépenses fonctionnelles de 15 pays de l'Union Européenne (UE). Ce chapitre se base sur un large échantillon de 53 pays développés et émergents sur la période 1980-2011. La stratégie d'identification se base sur l'estimateur système-GMM de Blundell et Bond (1998). Ce choix se justifie pour plusieurs raisons. Premièrement, l'utilisation de la méthode des Moindres Carrés Ordinaires conduirait à des estimations biaisées, car elles ne tiennent pas compte des hétérogénéités inobservées. Cependant, l'estimateur des effets fixes par pays n'est également pas adapté lorsque la dimension du panel est courte, en raison de la corrélation entre variable dépendante décalée et le terme d'erreur (Nickell, 1981). En plus, Hauk et Wacziarg (2009) soulignent que l'estimateur à effets fixes aggrave le biais lié aux erreurs de mesure et sous-estime l'impact des variables explicatives dans un panel dynamique avec des variables hautement persistantes dans le temps, comme c'est le cas avec notre panel. Deuxièmement, l'estimateur GMM en différence n'est pas non plus adapté pour l'estimation

dans notre cas de figure. Bien qu'il corrige le biais d'hétérogénéité et réduit les problèmes d'endogénéité, cet estimateur fait face à un problème de faible instrument en raison de la faible corrélation entre les variables retardées de niveau et les variables de première différence en présence de persistance dans le temps (Alonso-Borrego et Arellano, 1999). Troisièmement, le système-GMM fournit des estimateurs plus cohérents et efficaces que la différence-GMM dans les panels dynamiques en présence de variables hautement persistantes au fil du temps ((Blundell et Bond, 1998) et (Blundell et al., 2001)). Enfin, le système GMM fournit un biais plus petit (en termes de taille) que la différence-GMM ou les effets fixes estimateurs, même lorsque la condition stationnaire requise est douteuse (Hauk et Wacziarg, 2009).

Les résultats obtenus sont intéressants. Premièrement, tout en confirmant que les consolidations budgétaires réduisent à la fois les investissements publics et les dépenses courantes en pourcentage du PIB, appelé « effet de niveau », nous trouvons que les restrictions budgétaires réduisent le ratio investissement public – consommation courante. Par conséquent, les investissements publics devraient diminuer plus que la consommation publique pendant les consolidations budgétaires, ce qui est qualifié d' « effet de composition ». Deuxièmement, nous étudions la robustesse de nos résultats par rapport à une source importante de débat, à savoir la définition des consolidations budgétaires. En plus de la méthode décrite par Alesina et d'Ardagna (2013), nous considérons différentes durées pour définir un épisode de consolidation budgétaire, ainsi que les définitions endogènes des consolidations budgétaires selon Yang et al. (2015). Les estimations avec ces mesures alternatives confirment l'existence d'un effet de composition, et cette baisse du ratio des investissements publics par rapport à la consommation reste robuste en contrôlant l'effet des périodes sans rapport avec les consolidations ainsi que celui de plusieurs autres variables de contrôle supplémentaires. Troisièmement, nous explorons la sensibilité de l'effet de composition par rapport aux conditions budgétaires, à l'état général de l'économie et à la présence de crises. Les estimations montrent que les consolidations réduisent de manière significative le ratio investissement-consommation publique dans un contexte d'endettement élevé, lorsqu'elles sont fondées sur les dépenses, et dans la phase basse du cycle. Ensuite, nous constatons que la contraction

de l'investissement public par rapport à la consommation peut être jusqu'à quatre fois plus élevé dans les pays non-membres de l'OCDE par rapport aux pays de l'OCDE après les consolidations budgétaires. De plus, d'autres estimations révèlent qu'un effet de composition se dessine lorsque les consolidations budgétaires interviennent après les crises boursières et en particulier après les crises de la dette. Enfin, nous évaluons l'effet des consolidations budgétaires sur les composantes des dépenses publiques. Si la contraction des investissements publics est nettement plus forte que celle des salaires et dépenses de santé, les consolidations budgétaires réduisent l'investissement public plus rapidement que les dépenses en transferts et subventions.

Ce chapitre suggère que la prudence devraient être observée durant l'implémentation des politiques d'austérité, au cours desquels des consolidations budgétaires, visant à court terme la stabilisation, peuvent nuire à l'économie à long terme en raison de leur effet néfaste sur les investissements publics.

CHAPITRE 3 : LES EFFETS DE LA CONSOLIDATION BUDGETAIRE SUR L'EFFICIENCE DES INVESTISSEMENTS PUBLICS

Le chapitre 2, ainsi que la littérature y afférant, a mis en exergue une réduction des investissements publics plus drastique que celle de la consommation courante. Ce résultat s'explique par la logique électorale dans laquelle s'inscrit les gouvernements. Une réduction des dépenses courantes telles que les transferts et les salaires pourrait entrainer des manifestations populaires et affecter la probabilité de réélection du parti politique en place. Le cas des « Gilets Jaunes » en France est une illustration parfaite de cet argument. Ainsi donc, les ajustements budgétaires seraient défavorables aux investissements publics. À première vue, la baisse de l'investissement public peut entraîner un fort impact négatif sur l'économie. En effet, plusieurs articles théoriques et empiriques mettent en évidence le lien positif entre infrastructure publique et développement économique (Canning et Pedroni (1999); Demetri-

ades et Mamuneas (2000); Esfahani et Ramirez-Giraldo (2003)). À ce titre, une tentative de stabilisation à court terme, à travers les consolidations budgétaires, peut nuire à l'économie à long terme en raison de l'effet pervers sur les investissements publics.

Cependant, une autre partie de l'histoire mérite notre attention. En effet, il semblerait qu'une grande partie des effets positifs de l'investissement public sur la croissance économique découle de sa qualité plutôt que sa quantité.

Le point de départ de cette réflexion vient de l'article de Pritchett (2000). L'auteur s'est interrogé sur les effets positifs importants de l'investissement public sur la croissance, trouvé dans les études empiriques. Il souligne que l'utilisation du taux d'investissement ou l'effort cumulé d'investissement déprécié (CUDIE) conduit à surestimer l'impact, car cet indicateur ne tient pas compte de l'efficience du capital public. Après Pritchett (2000), plusieurs contributions soutiennent cette idée et fournissent des preuves théoriques et empiriques mettant en évidence l'efficience comme déterminant clé des impacts sociaux et économiques du capital public (FMI (2015); Gupta et al. (2014); Furceri et Li (2017)).

Ce chapitre tente de faire la lumière sur le rôle des contractions budgétaires dans la constitution du stock de capital public productif dans 53 pays développés et émergents sur la période 1980-2011. Nous étudions les effets de la compression budgétaire sur l'efficience des investissements publics. Nous contribuons à la littérature existante en plusieurs points. Premièrement, nous mettons en lumière le lien entre les consolidations budgétaires et l'efficience de l'investissement public au niveau macroéconomique. Deuxièmement, nous élargissons le débat sur les effets expansionnistes ou récessifs des consolidations budgétaires en mettant en évidence le canal de l'efficience. Comme recommandé par le FMI (2019), les gouvernements devraient concevoir des programmes de stabilisation budgétaire propices à la croissance afin de réduire la vulnérabilité de la dette et créer des « tampons » en cas de récession majeure. Un impact positif des consolidations budgétaires sur l'efficience des investissements publics peut conduire à une amélioration de la productivité du capital. Une augmentation de l'efficience peut être comprise comme une gestion et une redistribution optimales des dépenses publiques dans des secteurs économiques stratégiques et propices à la crois-

sance. L'ajustement budgétaire pourrait alors être favorable à la croissance s'il parvient à améliorer l'efficience des investissements publics. Troisièmement, nous construisons un indice d'efficience des investissements publics en suivant la nouvelle approche en deux étapes de Kumbhakar et al. (2015). Cet estimateur fournit un score plus cohérent et précis de l'efficience tout en séparant l'efficience de long terme et celui de court terme. Quatrièmement, nous utilisons la méthode d'estimation AIPW de Jordà et Taylor (2016) pour estimer l'effet final. Cette méthode combine l'évaluation d'impact et l'approche de projection locale. Le premier avantage de cette stratégie consiste à contrôler le problème de biais d'allocation en raison de l'absence d'assignation aléatoire des épisodes d'ajustements budgétaires. Le deuxième avantage est l'estimation à « double robustesse », ce qui signifie que cet estimateur ne nécessite qu'un seul modèle (entre le traitement et le résultat) soit bien spécifié. Le troisième avantage repose sur la capacité de la projection locale à calculer des estimations variantes dans le temps et non linéaires, utilisant peu de restrictions à d'autres modèles.

Nos résultats suggèrent que les pays qui ont connu des épisodes de consolidation budgétaire améliorent considérablement leur efficience d'investissement public jusqu'à 5 ans après le début du choc. L'ampleur des effets moyens du traitement varie de 0,98 (pour l'année d'ajustement) à 3,96 points de pourcentage (5 ans après le choc). Ces résultats sont robustes à diverses définitions endogènes des consolidations budgétaires, à l'extension du modèle de traitement et de résultat, aux estimateurs alternatifs pour l'efficience ainsi qu'aux hypothèses alternatives sur le score de propension.

Plusieurs canaux de transmission peuvent expliquer ses résultats. Le premier canal repose sur la volonté des gouvernements d'assurer la croissance à long terme des économies. En effet, les ajustements budgétaires fondés sur les dépenses reposent principalement sur la réduction des investissements. La baisse des investissements publics peut impacter le développement du secteur privé (consommation et investissement) ainsi que la croissance de la production à long terme. Avec un espace budgétaire limité, le seul moyen de préserver la trajectoire de croissance et de réussir les consolidations budgétaires serait d'accroître la productivité des investissements publics et, qui à leur tour, vont accroitre le capital public productif.

L'amélioration de la productivité nécessite une meilleure gestion des ressources rares et plein emploi de la capacité de l'économie. Cela conduit alors à une augmentation de l'efficience. Le deuxième canal se réfère aux conditions budgétaires entourant les ajustements et la volonté des gouvernements de convaincre les créanciers et les marchés financiers de la crédibilité de la stratégie de soutenabilité du déficit. En effet, les consolidations budgétaires surviennent la plupart du temps avec des conditions budgétaires spécifiques comme une dette et un déficit élevés, une croissance faible, etc. Ces conditions diminuent la confiance et la notation des marchés financiers sur le pays, ainsi qu'augmente le pessimisme des créanciers et le risque de défaut souverain perçu. En revanche, des consolidations budgétaires, réussies et favorables à la croissance, exigent la crédibilité des gouvernements auprès des marchés financiers, preuve de la solvabilité financière du pays. Comme l'a démontré Edwards (1985), le comportement d'investissement donne un signal positif aux acteurs des marchés par la réduction des spreads des obligations souveraines. Pour être productifs, les investissements devraient avoir une haute qualité en termes de mise en œuvre et de gestion. En d'autres termes, l'amélioration de la qualité du capital public réduit le pessimisme des créanciers et contribue à diminuer la perception du risque souverain. À la fin, les gouvernements devraient augmenter l'efficience des investissements publics au cours des programmes d'assainissement budgétaire afin d'atténuer le pessimisme des créanciers et augmenter les chances de succès de ce programme. Le troisième canal explore la présence de programmes d'organisations internationales, telles que les programmes soutenus par le FMI, pendant les périodes de consolidation budgétaire. Comme l'a souligné l'IEO (2003), les programmes du FMI comporte en grande partie des objectifs d'ajustement budgétaire. Ces programmes comprennent certaines conditionnalités et assistance technique (ainsi que la formation). Plus précisément, des règles sur mobilisation des revenus et / ou la gestion des dépenses sont quelques exemples de conditionnalité (Crivelli et Gupta (2016); Gupta et al. (2018)). Ces conditionnalités conduisent les gouvernements à s'engager dans des réformes structurelles pour renforcer l'efficience du secteur public. Grâce à la formation et à l'assistance technique, le FMI peut encourager des réformes clés en sensibilisant sur les derniers développements dans la discussion académique

et politique ainsi que sur les meilleures pratiques internationales.
Pour mettre en lumière ses canaux, nous entreprenons un intéressant exercice de sensibilité aux conditions budgétaires (perception du risque souverain), à la dépendance de l'État à l'économie (cycle économique et stade de développement), à la présence de programmes soutenus par le FMI et la mise en œuvre d'une politique monétaire accommodante (dépréciation réelle et faible taux directeur). Il en ressort que les consolidations budgétaires stimulent davantage la productivité du capital public dans les pays émergents pendant la phase descendante du cycle et avec un risque perçu élevé de défaut souverain. En outre, nous continuons à gagner en efficience, grâce aux consolidations budgétaires, dans le cadre d'un programme FMI et lorsque le gouvernement augmente la compétitivité grâce à une dépréciation du taux change réel effectif.

Ce chapitre montre que les consolidations budgétaires peuvent assurer une trajectoire de croissance économique durable à long terme s'ils améliorent la qualité de la gestion du gouvernement, en particulier dans le secteur des investissements publics.

CHAPITRE 4 : L'EFFICIENCE DES INVESTISSEMENTS PUBLICS DANS LA ZONE UEMOA : LE ROLE DES SOURCES DE FINANCEMENT

Les Etats de l'Union Economique et Monétaire Ouest Africaine (UEMOA) se sont engagés depuis une dizaine d'années dans de vastes programmes d'investissements publics. Ces engagements se sont traduits par un accroissement fulgurant de la part des investissements publics dans le PIB. Elle a plus que doublé entre 2005 et 2015 en passant d'environ 4,0% à 9,8%. Cette évolution est le reflet de la volonté des Etats de l'Union de rattraper le retard accusé en matière d'infrastructures. En effet, selon le Fonds Monétaire International (FMI), les Etats de l'UEMOA ont un niveau de développement des infrastructures relativement faible par rapport à certains pays d'Afrique subsaharienne tels que le Ghana, le Kenya, le Malawi et le Rwanda. Cette insuffisance est plus marquée dans le secteur des infrastruc-

tures d'approvisionnement en électricité, de transports et de télécommunications. Dans un contexte de faible mobilisation des ressources fiscales, les Etats ont souvent eu recours à des emprunts coûteux pour financer leurs investissements. Ceci se traduit par un accroissement du déficit budgétaire et une dette en rapide reconstitution après les allègements obtenus avec les initiatives PPTE et IADM.

Cette hausse du déficit budgétaire et de l'endettement pourrait devenir problématique si les investissements publics réalisés ne sont pas suffisamment efficients pour générer une croissance à même de dégager des recettes permettant de faire face aux engagements contractés. Par ailleurs, le recours croissant à l'endettement, notamment sur le marché régional de la dette publique, pourrait fortement impacter le cadre macroéconomique des Etats de l'UEMOA, à travers l'accroissement du risque souverain qui peut peser sur la stabilité financière. En outre, la stagnation (voir même la baisse) des investissements privés, en pourcentage du PIB, dans la zone UEMOA, sur la période 2007-2016, au profit des investissements publics suscite des interrogations sur la capacité de ces derniers à stimuler la croissance et dynamiser l'économie de la zone.

Il semble donc utile d'analyser l'efficience de l'investissement public dans l'UEMOA afin d'évaluer la rentabilité de ces investissements et leur capacité à compenser les effets négatifs de l'augmentation du déficit et de la dette des États de l'UEMOA sur leurs économies. La littérature sur l'évaluation de l'efficience des dépenses publiques se développe. Plusieurs articles fournissent des comparaisons de la gestion des dépenses publiques dans divers secteurs économiques, y compris l'éducation (Afonso et Aubyn, 2006b; Witte et López-Torres, 2017) et la santé (Grigoli et Kapsoli, 2013; Schwellnus, 2009) ainsi que l'analyse multisectorielle (Herrera et Ouedraogo, 2018).

Certains articles mettent l'accent sur l'efficience des investissements publics. Dabla-Norris et al. (2012) développent un indice de mesure de la gestion des investissements publics (PIMI) basé sur quatre étapes critiques du processus de décision d'investissement public à savoir l'appréciation, la sélection, la mise en œuvre et l'évaluation du projet. Gupta et al. (2014), en s'appuyant sur l'indice PIMI, calculent un stock de capital public, ajusté

de l'efficience, pour refléter la qualité des investissements publics. De plus, le FMI (2015) propose un indice d'évaluation de la gestion des investissements publics (PIMA). Ce nouvel indice améliore le PIMI en prenant en compte le cadre macroéconomique de la décision d'investissement public tels que les règles budgétaires, la coordination de la composante gouvernementale, le suivi des programmes de partenariat public-privé (PPP) ainsi que la gestion des entreprises publiques. Albino-War et al. (2014) utilisent l'analyse des méthodes de l'enveloppement des données (DEA) et de la coque à stockage libre (FDH) pour calculer les scores d'efficience des investissements publics pour les pays du Moyen-Orient et l'Afrique du Nord (MENA) et ceux du Caucase et d'Asie centrale (CCA) exportateurs de pétrole . Ils trouvent qu'il est nécessaire d'améliorer la gestion des investissements publics pour ces pays. Le FMI (2015) utilise également une analyse de frontière non-paramétrique sur plus de 100 pays avancés, émergents et en développement. La comparaison entre la valeur du capital public (intrant) et les mesures sur la couverture et la qualité des infrastructures (extrants) d'un pays à l'autre révèle des inefficiences moyennes dans les processus d'investissement public d'environ 30 pour cent.

Cependant, un petit nombre d'articles s'intéresse aux pays de l'UEMOA pour évaluer la qualité de la gestion des investissements publics. SOUMAILA (2014) analyse l'efficacité de l'investissement public dans l'Union en utilisant le ratio différentiel de production de capital (ICOR). Il constate que l'investissement public dans l'UEMOA est moins efficace que celui d'un groupe de pays. Cependant, l'utilisation de l'ICOR reflète plus l'efficacité que l'efficience d'investissement public. Barhoumi et al. (2018) évaluent l'efficience de l'investissement public dans l'UEMOA par rapport à un groupe de pays de référence utilisant la méthode des frontières d'efficience. Ils constatent que la quantité et la qualité des investissements publics restent faibles dans l'Union. Cependant, ils ne tiennent pas compte de deux questions importantes. Premièrement, ils ne font pas de distinction entre efficience managériale et efficience technologique. Tandis que l'efficience managériale se réfère à la capacité de gérer les ressources afin de maximiser le rendement, l'efficience technologique décrit la performance du modèle de production. Dans le contexte des dépenses publiques, l'efficience technologique se

réfère à la performance de l'environnement qui entoure la gestion des investissements publics. La distinction est assez importante dans le cadre de comparaisons internationales entre pays avec hétérogénéité dans l'échantillon. Deuxièmement, Barhoumi et al. (2018), ainsi que d'autres études dans le domaine de l'efficience, ne se penche pas sur la relation entre les sources de financement et l'efficience. Bien que les facteurs institutionnels et l'ampleur des dépenses du gouvernement sont bien connus comme déterminants de l'efficience du gouvernement (p. ex. Hauner et Kyobe (2010)), il n'y a pas de preuve empirique de l'impact potentiel des sources de financement sur l'efficience des dépenses publiques. Bien que l'investissement public soit de plus en plus financé par la dette publique, nous ne savons pas comment la composition de cette dette, à savoir dette domestique (y compris dette régionale) ou extérieure, a un impact sur la qualité des dépenses publiques. L'étude de cette question est assez pertinente pour les pays en développement en raison des avantages potentiels de la dette intérieure (Panizza (2008)) et surtout dans le contexte des pays de l'UEMOA où il existe un soutien pour l'utiliser (par exemple Guérineau et Guillaumont (2007)).

En utilisant la méthode de la méta-frontière à la Huang et al. (2014), nous étudions l'efficience des investissements publics dans les pays membres de l'UEMOA sur la période 2006-2015, dans la mesure où ces facteurs déterminent en quelque sorte la rentabilité de ces investissements et leur capacité à compenser les effets négatifs de l'endettement élevé des États de l'UEMOA sur leurs économies. Notre étude contribue à la littérature en deux points principaux. Tout d'abord, nous nous concentrons sur l'efficience de l'une des régions les plus dynamiques d'Afrique subsaharienne en termes d'investissement public en distinguant l'efficience managériale (en particulier l'efficacité technique) de l'efficience technologie. Deuxièmement, nous soulignons l'impact du mode de financement de l'investissement sur son efficience. Nos résultats suggèrent que les pays de l'UEMOA sont moins efficients que l'Afrique subsaharienne et les pays de référence asiatiques. Cependant, la décomposition de l'efficience globale en efficience technique et technologique, révèle que les pays de l'UEMOA sont plus efficients que les pays subsahariens en termes d'efficience technologique. L'évaluation des sources de financement indique que la dette extérieure exerce un effet plus

positif et significatif sur l'investissement public par rapport à la dette intérieure. La conditionnalité liée à la mobilisation des ressources extérieures assure leur meilleure gestion par rapport à la dette intérieure qui provient du marché régional, où certains gouvernements utilisent des ressources de long terme pour financer les dépenses courantes.

Ce chapitre suggère d'améliorer significativement l'utilisation des ressources tirées de l'endettement intérieur, notamment à travers le marché régional de la dette publique. Cela peut pratiquement se faire à travers la création d'une compétition pour l'accès aux ressources sur le marché régional. Plus l'accès à l'endettement intérieur est compétitif et rigoureux, plus il est espéré que la ressource sera utilisée à bon escient. Cette compétitivité pourrait prendre la forme de grille de notation et intègrera les facteurs de bonne gouvernance, de viabilité de la dette et d'utilisation de la ressource.

CHAPITRE 5 : L'ANALYSE DES MULTIPLICATEURS BUDGETAIRES EN AFRIQUE: L'APPROCHE DSGE NEO-KEYNESIENNE

L'analyse des effets de la politique budgétaire est une question omniprésente depuis les années 1960. Alors qu'une grande partie la littérature s'est concentrée sur la politique monétaire comme l'un des principaux moteurs de la croissance à court terme dans les années 80, les crises successives, notamment la crise financière de 2007-2009, ont relancé le débat sur l'importance et / ou les effets des mesures discrétionnaires du gouvernement sur l'économie par le biais des plans de relance budgétaire (utilisés pour éviter une autre grande récession) ou des consolidations budgétaires (utilisées pour stabiliser le déficit budgétaire).
La littérature sur les contributions théoriques et empiriques pour comprendre le rôle de la politique budgétaire est vaste et loin d'être consensuelle. La diversité dans la nature et la taille des multiplicateurs budgétaires découle principalement de la méthodologie et de la stratégie d'identification mis en œuvre par des chercheurs.

Un premier volet de la littérature repose sur les méthodes des formes réduites, en parti-

culier le vecteur autorégressif (VAR), avec différentes approches d'identification. Premièrement, ces études supposent que les dépenses publiques ne réagissent pas au PIB et aux impôts durant le premier trimestre de l'année. Par conséquent, ces études révèlent un impact important des dépenses publiques sur le PIB ainsi qu'un effet d'entrainement sur la consommation privée (par exemple (Blanchard et Perotti, 2002; Fatás et al., 2001).
Un examen approfondi de cette littérature met en lumière différentes estimations de l'impact des dépenses publiques sur le PIB en raison de contraintes liées à l'identification des actions discrétionnaires des gouvernements. En effet, si Blanchard et Perotti (2002) trouvent un multiplicateur des dépenses publiques proche de l'unité, Fatás et al. (2001) présentent une estimation supérieure à un. Toutes ces études se réfèrent à l'économie américaine. Deuxièmement, certaines études s'appuient sur l'approche Ramey-Shapiro. Cette approche consiste à utiliser certaines dates de guerre pour identifier l'augmentation inattendue des dépenses de défense qui sont complètement exogènes à l'économie américaine. L'idée est que les épisodes de guerre reflètent le changement discrétionnaire de la politique budgétaire et peut être utilisé comme tel. Ces documents trouvent un effet relativement faible des dépenses publiques sur le PIB et un effet d'éviction de la consommation privée (Burnside et al., 2004; Ramey, 2011; Ramey et Shapiro, 1999). Cependant, Ramey (2011) montre que l'on peut prévoir une augmentation des dépenses militaires et non militaires plusieurs trimestres avant leur apparition. Par conséquent, il est important de saisir le calendrier des nouvelles concernant les futures augmentations des dépenses publiques. Ses estimations de multiplicateur, basées sur une extension des "dates de guerre" de Ramey et Shapiro (1999) et de nouvelles séries de données sur les nouvelles, se situent entre 0,6 et 0,8 lorsque la Seconde Guerre mondiale est exclue, et proche de l'unité avec la Seconde Guerre mondiale. Des résultats empiriques similaires sont rapportés par (Barro et Redlick, 2011). Cependant, une leçon de la littérature ci-dessus est qu'il est important de tenir compte du moment et de la nature d'anticipations pour estimer les effets de la politique budgétaire.

Un deuxième volet de la littérature s'appuie sur des modèles macroéconomiques structurels, plus spécifiquement sur les modèles d'équilibre général calculable dynamique (DSGE).

Les modèles DSGE présentent deux principaux avantages par rapport aux modèles à formes réduites. Premièrement, ces modèles incluent des fondations micro-économiques sous-jacentes, permettent de modéliser les anticipations rationnelles et fournissent une réponse relativement crédible à la critique de Lucas. Deuxièmement, les chocs dans DSGE, compris comme la description des processus exogènes, fournissent des interprétations économiques directes par rapport aux modèles VAR où il est nécessaire d'identifier indirectement les chocs exogènes en utilisant la forme réduite des résidus. L'utilisation des modèles DSGE a considérablement augmenté ces dernières années, à la fois pour l'analyse de la politique budgétaire et de la politique monétaire. En ce qui concerne l'analyse de la politique budgétaire, nous pouvons distinguer deux théories majeures qui influencent l'ampleur des multiplicateurs budgétaires utilisant ces modèles, à savoir la théorie néoclassique et la théorie keynésienne.

D'un côté, l'approche néoclassique prévoit un multiplicateur positif pour le PIB ainsi qu'un effet d'éviction sur la consommation privée. En effet, les hypothèses sous-jacentes de ces modèles mettent en évidence un effet de richesse négatif après la hausse des dépenses publiques. Les gouvernements, en augmentant les dépenses publiques, réduisent les ressources disponibles pour le secteur privé tout en donnant le signal aux ménages d'une future hausse des impôts. À ce titre, les agents économiques réduisent leur consommation et augmentent leur temps de travail, et donc augmentent l'activité économique. Selon les économistes néoclassiques, le multiplicateur de dépenses positif sur le PIB agit à travers le canal de l'offre (Ramey, 2019). Baxter et King (1993), l'un des principaux articles dans l'approche néoclassique, analysent les multiplicateurs de dépenses publiques à l'aide d'un DSGE standard modèle. Ils constatent un impact négatif de la politique budgétaire, de taille 2,5, si les dépenses publiques sont financées par des taxes de distorsion et si l'augmentation des dépenses publiques est temporaire. Alors que les dépenses publiques financées par le déficit conduisent à des multiplicateurs inférieurs à 1, les dépenses publiques financées par des taxes forfaitaires induisent de grands multiplicateurs. Dans ce dernier cas, l'impact de l'évolution des dépenses est inférieur à l'unité à court terme et autour de 1,2 à long terme.

D'un autre côté, l'ampleur du multiplicateur budgétaire de l'approche keynésienne est étroite-

ment liée à la propension marginale à la consommation. En effet, le multiplicateur de base des dépenses publiques est équivalent à $1/(1 - mpc)$ tandis que $-mpc/(1 - mpc)$ pour les taxes, pour un taux d'intérêt inchangé. La taille et l'ampleur du multiplicateur dépendent de plusieurs caractéristiques (Ramey, 2019). Galí et al. (2007), sur la base de leurs hypothèses sur la règle de de consommation et l'emploi déterminé par la demande, représente une illustration de l'approche keynésienne. Ils trouvent un multiplicateur positif et élevé des dépenses publiques d'environ 2,0.

Cependant, plusieurs points mettent en évidence des divergences entre les deux modèles néoclassiques et keynésiens et les données observées. Premièrement, la tradition keynésienne standard ne tenir pas compte des anticipations rationnelles qui est une caractéristique importante du programme d'optimisation des ménages. Deuxièmement, la plupart des modèles néoclassiques supposent l'idée de l'équivalence ricardienne, ce qui n'est pas vraiment vrai dans le monde réel (Diamond, 1965; Seater, 1993).

Dans le but de réconcilier ces deux approches, les chercheurs ont développé le DSGE néo-keynésien qui intègre certaines caractéristiques des modèles néoclassiques telles que les rigidités du travail et des prix ainsi que les anticipations des entreprises et des ménages. Principalement utilisé dans l'analyse de la politique monétaire, le DSGE néo-keynésien est de plus en plus mis en œuvre dans l'analyse de la politique budgétaire depuis Cogan et al. (2010). Ces auteurs s'appuient sur le célèbre modèle de Smets et Wouters (2003, 2007) pour évaluer les effets du programme de relance des Etats-Unis en 2009, suite à la crise financière, sur l'économie américaine. Selon Woodford (2009), le modèle Smets et Wouters représente un des principaux cadres macroéconomiques pour analyser les politiques. Il donne l'une des meilleures représentations de la pensée actuelle en macroéconomie.

Dans cet article, nous nous appuyons sur le modèle de Smets and Wouters (2003, 2007) et l'élargissons pour évaluer le multiplicateur des dépenses publiques sur les économies africaines, avec une application sur l'Afrique du Sud. Notre article contribue à la littérature en plusieurs points. Premièrement, malgré l'augmentation de l'adoption du modèle DSGE pour l'analyse des politiques macroéconomiques dans les pays développés et émergents, il y

a eu très peu de documents portant sur la prévision de la politique budgétaire en Afrique. En effet, Olofin et al. (2014) est l'un des premiers articles à développer une approche pragmatique du Modèle DSGE pour éclairer les prises de décisions de la banque centrale du Nigéria. L'étude a proposé et analysé les effets de trois politiques qui sont construits autour des hypothèses des changements que la banque centrale est susceptible de faire au taux de politique monétaire. Gupta et al. (2015) estiment un modèle DSGE de prévision de l'inflation en Afrique du Sud. Ils ont constaté que le DSGE est extrêmement efficace pour prévoir les variables d'inflation par rapport aux prévisions rapportées par d'autres modèles tels que les modèles autorégressifs. Cependant, ces articles sont axés sur les performances entre les VAR et les DSGE plutôt que sur l'analyse des multiplicateurs budgétaires. Deuxièmement, nous introduisons plusieurs caractéristiques pour s'adapter aux caractéristiques des économies africaines. En effet, nous développons un modèle de petit économie ouverte selon Medina et al. (2005) et Dib (2008) et nous intégrons le secteur des matières premières. Ce secteur est une caractéristique structurelle de l'économie en Afrique. Deuxièmement, nous supposons que le taux de dépréciation du stock de capital en tant que fonction croissante et convexe suivant Schmitt-Grohé et Uribe (2012). Troisièmement, nous supposons que le taux d'intérêt sur la dette extérieure inclut une prime de risque selon Adolfson et al. (2007), la prime de risque augmente en fonction des actifs étrangers à produire.

Nos résultats suggèrent qu'une augmentation de 10 % des dépenses du gouvernement entraîne une réaction positive du PIB jusqu'à 2 points de pourcentage immédiatement le choc. Cette réponse décroit mais reste positive jusqu'à 8 trimestres après le choc. En d'autres termes, une augmentation de 1 % des achats du gouvernement entraine une augmentation du PIB de 0,2 %. Ces résultats sont conformes à la littérature sur la nouvelle keynésienne. Concernant la consommation et l'investissement privé, l'évolution des dépenses publiques induit une réduction des deux composantes. Cependant, un accroissement de la demande conduit à une inflation à court terme suivie d'une stabilisation rapide.

Contents

Chapter 1

General Introduction

The intervention of government in the economy has never been as necessary and expected as during the coronavirus crisis that we are experiencing. The number of countries as well as the important amount of fiscal stimulus plan have never been seen before. While the US senate has approved a historic plan of $2 trillion, the French government has engaged in a 100 billion euros stimulus package to mitigate the adverse effects of this outbreak on the economy. If this exceptional fiscal policy has been unanimously acknowledged by economists, the presence of fiscal policy in the economy has not always been obvious in the history. Let get back to almost a century to well understand.

1.1 Fiscal policy from Keynes

The intervention of government in the economy activity has been recognized and formally occurred during the 1929 Great Depression. Indeed, the crisis of 1929 led to an unprecedented downturn of the economy with stock market collapse and high unemployment rate. Between 1929 and 1933, industrial production declined by 47 %, gross domestic product (GDP) fell by 30 % and unemployment rate rose above 20 %. In this difficult situation, John Maynard Keynes put forward the idea that the increase of public demand will increase the production of goods and services by private sector, and as such will reduce unemployment as well as increase output. Following this theory, the government of United States implemented a huge demand stimulus program called the New Deal. The first phase of the plan was related to relief with food and shelter for millions of US citizens. This is exactly what the US government did to response to COVID-19 pandemic through the distribution of stimulus checks. The second phase of the New Deal plan focused on the recovery with creation of governmental agencies including National Recovery Act and National Industrial Recovery Act in 1933. To convince the economists and policymakers, John Maynard Keynes has highlighted several arguments in its famous book: "the General Theory of Employment, Interest and Money". The book was written in the context where the predominant economic thought was the classical view. For this wisdom, the market is efficient to adjust between supply and demand in order to always find the general equilibrium. Economic agents produce

in order to either consume their production or sell their products to buy products of other individuals. The underlying assumption of this model is as follows: the existence of surplus of goods and services will systematically lead to the reduction of price to the point where they would be consumed. Given the high and persistence unemployment during the Great Depression, Keynes supported the idea that it would be highly improbable for aggregate demand to absorb the entire production of goods and high unemployment, especially during the collapse of economy. Keynes was convinced that economy was not able to recover itself and government should react and increase the purchasing power of workers through public spending.

Following Keynes, several contributions in the literature highlight the importance of fiscal policy in economy recovery in difficult situations. For example, Lee et al. (2009) highlight the fact that there is a small likelihood for economy to get back to its pre-crisis growth rate after a downturn due to major financial and/or economic crises. To mitigate such impact and sharply recover from recession, short run stimulus policies should be put in place at the beginning of the recession.

1.2 Limits of Keynesian model

Fiscal policy remains very popular and useful tool in the economy until 1970s. Indeed, most of the economists were convinced that inflation was inversely correlated to unemployment. Under the influence of Keynesian economy model, the conventional wisdom was an increase in global demand for goods would lead to an increase in price level. This price hike will conduct firms to produce more and as such hire additional workers, leading to supplementary demand into the economy. In other words, inflation was acceptable since it reflected the growing of economy and reduction of unemployment. However, several developed countries in the world experienced a stagflation during the 1970s. Stagflation is a mix of slow economy growth and high inflation as well as high unemployment sometimes. In US, for example, the consumer price index (CPI) grew up to 13.5% in 1980 while the unemployment level reached 8.5% in 1975. The economy was hit by two recessions during the 1970, one

from December 1969 to November 1970, and another from November 1973 to March 1975. In addition, expansionary fiscal policy has generated a couple of worrying trends in public spending and debt. We observed significant increase in public spending and deficits during 1960s and 1980s in several countries in the world, especially industrialized countries.

On the one hand, Roubini and Sachs (1989) analyzed the evolution of government spending and budgets deficit in 15 OECD countries. Their investigation revealed two important trends in fiscal variables. First, there was a significant and fast increase in public spending during 1970s, specifically after 1973. The increase was higher on average during 1965-1973 period and most rapid during 1973-1982 timeframe. For example, the government spending to GDP ratio increased from 38.4% in 1965 to 51,1% in 1982 while for Germany from 36.6% to 49.4% within the same period. The average public spending of OECD economies shifted from 29.5% in 1965 to 41.0% in 1985, that represented a considerable evolution. According to Roubini and Sachs, this increase was correlated with the downturn trend in the economy after 1973. To recall, 1973 represents the first oil shock in the history, with severe consequences in economy of OECD. Second, there was an increase in debt to GNP ratios and fiscal deficit after 1973. Indeed, almost all OECD countries have experienced an increase in debt to GNP ratios during 1973-1986 period. For instance, Ireland debt level shifted from 32.0 % to 108.2 % while Italy experienced a rise from 45.1 % to 84.9 %. Regarding the fiscal deficit, the government fiscal surplus sharply shifted from 0.1 % of GDP in 1973 to a deficit of 0.5 % in 1974 and of 3.8 % in 1975. One of the reasons for such observation is the presence of cyclical factors such as the growth reduction and rise in unemployment after 1973. As highlighted above, the Keynesian theory suggests that government needs to increase a public demand during adverse shock to counteract the cycle and boost the economy activity. In addition to that, the increase of unemployment automatically rises government spending through the increase in social benefits and transfers. Another interesting observation of these trends is the closer look at of the composition of government spending. It clearly appears that the most important component of the increase in government consumption is the interest payment of debt.

On the other hand, De Haan et al. (1992) identify two phases of expansions in the trend of public finances in the European community. The first phase reflects a quite balanced expansion of public sector in 1960s. Government spending to GDP ratio went up rapidly in most of the countries accompanied by the evolution of tax revenues and other revenues in same path, more and less. The increase in social protection benefits was the main driving force of the evolution of government spending at this time. This balanced expansion phase has reflected a common belief in the fiscal policy action in the economy and political preference to reduce income inequality. The second phase reflected the deterioration of government budgets during 1970s and the early 1980s. While the path of government spending continues to go up rapidly, public revenue does not follow this increase. Consequently, the net borrowing went up sharply, especially in the second half of 1970s. In addition, the public debt to GDP ratio rapidly increased after 1975. The economy slumps as well as high unemployment contribute to deteriorate the government budget positions.

1.3 The notion of sustainability

Tolerated under the Keynesian approach for its demand stimulus property, public debt and deficit expansion revived the debate around the sustainability of public finances. The notion of sustainability took roots in the early contributions of classical authors including Ricardo, Hume and Smith. Their analysis mainly focused on the general effects of government debt on economy, with comparison between tax and deficit financing of government spending. Sustainability can be defined as the characteristic of debt and deficit to continue to generate positive effect for the economy without provide a high risk of debt or deficit crisis. (Neck and Sturm, 2008). We can more understand this notion using the environmental economics framework. Researchers found several common features between public debt and renewable resources. Let us take the example of fishing grounds as renewable resource. Fishing grounds can be used up to a certain threshold. After this point, the reproductive capacity of the resource is harmed; the resource becomes a nonrenewable one and is finally consumed com-

pletely. Similarly, government debt and/or servicing could not be an issue for economy if it is sufficiently low. However, they can lead to debt crisis if it is overused. In addition, deficits present common features with pollutants. In a small proportion, pollutants can be released without damage given the absorption capacity of the nature. Beyond a certain point, their presence may lead to adverse externalities in a short run until the system will collapse in the long run. This is exactly the same mechanism for public finances. Sustainability is thus the mean to evaluate the threshold beyond that fiscal policy is harmful for the economy. Several authors have pointed out the unsustainability of publics finances after 1970s. Alesina and Ardagna (1998) highlighted that plenty of OECD countries have experienced huge public deficits that led public finances into unsustainable paths. Alesina et al. (1998) outline that industrialized and developing countries was facing to fiscal indiscipline. De Haan et al. (1992) highlight that the reorientation of fiscal policy during 1980s was mainly motived by the growing concern about the sustainability of public finances. One of the most worries was that high public deficits put pressure on interest rates and as such hinder private investment and economy growth.

For all these facts, most of governments engage in restrictive fiscal policy through fiscal consolidations.

1.4 Implementation of fiscal consolidations programs

Roubini and Sachs (1989) identify two major waves of fiscal consolidations in OECD. The first phase occurred during the 1976-79 period with the stabilization in government spending to GDP ratio around 38 % and the rise in tax revenues by 2 % of GDP on average, from 33.1 % to 35.1 %. Consequently, there was a relative improvement of fiscal balance of about 2 %, from -3.8 % in 1976 to -1.8 % in 1979. During the second phase of fiscal consolidation, from 1983 to 1986, we observed a mix of expenditure cuts and tax hikes, on average. Giavazzi and Pagano (1990) outline the implementation of substantial fiscal discipline exercises during 1981-1989 period with more and less success. For example, once observed an improvement in

fiscal position in Belgium, Denmark, Ireland, Sweden and United-Kingdom ranging between 3 % to 6.6 % of GDP. In France more specifically, governments have implemented several fiscal consolidations packages over the past four decades. These episodes include, amongst those followed huge fiscal imbalances, the "Plan Barre" in 1976, the "Virage de la rigueur" in 1983, the 1993-1997 fiscal plan before the entry in European Monetary Union (EMU), and five-year adjustment plan, called the Excessive Deficit Procedure (EDP) from 2003 to 2007, under the stability and growth pact (SGP). Amongst the emerging and developing countries, Latina America experienced a remarkable fiscal consolidation during the 1990s, with a sustainable reduction of the fiscal deficit by 3 % of GDP, relatively that of the 1980s (Gavin and Perotti, 1997). In addition, during the end of 1990s and the beginning of 2000s, several Latin American countries such as Argentina, Brazil, Ecuador and Peru have implemented fiscal consolidation packages under IMF programs. They also introduce various nominal threshold of the public budget and begun the settlement of stabilization funds. In Africa, structural adjustment programs begun "the new normal" during 1980s and 1990s. Pushed by World Bank, IMF and international donors, many African countries engaged in structural adjustment programs in order to mitigate the fall in output activity. A non-negligible part of these programs referred to expenditure cuts through reduction of social benefits and privatization of non-efficient state-owned enterprises (SOEs).

1.5 Anti-Keynesian effects of fiscal contractions

Widespread in the middle of 1990s, fiscal consolidation programs attract the interest of academics on several characteristics, especially their ability to improve and stabilize the fiscal position as well as their potential impact on economic activity. This interest for fiscal consolidation features increasingly gains momentum after the observation of some "anti-Keynesian" effects. Indeed, the conventional wisdom in the Keynesian tradition suggests that the increase in government spending will increase the global demand. To response to this demand, private agents will increase their production though rise of employment. This increase of employment will increase the purchasing power and lead to the increase

in consumption and at the end to global output. This is the principle itself of spending multiplier. Reversely, the contraction of public expenditure would probably lead to the shrinking of consumption and output. However, the stylized facts during fiscal consolidation episodes do not always confirm this theory. One of the early and seminal work on this subject is the paper of Giavazzi and Pagano (1990). Analyzing the effects of fiscal policy on 10 OECD countries during 1973-89, Giavazzi and Pagano realized that fiscal consolidation episodes, especially in Ireland and Denmark, have been accompanied by strong expansion of private consumption and reduction of debt to GDP ratio. While the full employment budget deficit has been reduced by 7.2 % during the 1983-86 Danish fiscal retrenchment and by 5.7 % during the 1987-89 Irish one, private consumption and investment rose sharply and steadily. In both cases, governments decided to cut public investment, increase net taxes and stabilize the real government consumption during fiscal adjustment. However, tax hikes in the Ireland case were mostly due to output expansion than fiscal stabilization program. Based on that, Giavazzi and Pagano (1995) and several other academics undertook the journey to understand the characteristics of successful and expansionary fiscal consolidations.

1.6 The trade-off between spending-based and tax based consolidations

Researchers, thorough the entire literature, have highlighted the importance of fiscal consolidation size and composition in debt reduction as well as economic growth support. Giavazzi and Pagano (1995) demonstrate the critical impact of consolidation size and lasting to boost growth and private consumption. Moreover, Ardagna (2004) finds that the success of fiscal consolidation to decline debt and push up growth relies more on consolidation size than composition. She explains that the likelihood of restrictive fiscal policy to reduce debt substantially increases when governments undertake large fiscal adjustments. Regarding the composition of fiscal adjustments, a great strand of literature considers that spending based fiscal adjustments are more efficient to reduce debt and deficit than tax-based adjustments.

McDermott and Wescott (1996), using a panel of 17 industrialized countries, find that consolidations led by cut in government spending improves the success probability of adjustment than those led by increase in taxation. Alesina and Ardagna (1998), relying on descriptive analysis, reveal that successful adjustments are mostly based on expenditure cut and the unsuccessful ones are exclusively related to taxes increase. Alesina and Ardagna (2013) show that fiscal adjustments led by public spending reduction are more likely to generate growth (and deficit reduction) than those led by tax hikes. There are some theoretical foundations related to these empirical findings. Indeed, the traditional neoclassic approach considers that fiscal policy triggers substitution effects between labor and leisure (and consumption). If it assumes that both consumption and leisure are normal goods, economic agent makes a trade-off between these goods and labor. He rises his labor supply if he estimates that the time reserved to work will increase more his satisfaction compared to the consumption of goods. In doing so, tax hikes lessen agent satisfaction coming from his labor relative to consumption one, for the same amount of sacrifice time. He then will reduce his labor time. This reduction will slow down economy path and increase government expenditure that leads to adjustment failure. Another explanation of tax-based consolidations failure stems from analysis of unionized labor markets. Ardagna (2004) reveals that increasing taxes, especially, income tax, shrink after-tax real wages and as such push labor unions to ask for an increase in pre-tax real wages. This increase will lead to a higher equilibrium wage rate and decrease the equilibrium level of employment as well as capital shadow value. As result, capital accumulation and growth will be slowed and negatively impacted. Further, tax hikes may have distorting effects on the economy. Barro (1990) argues for the existence of a Laffer curve between growth and tax rate. These distortions may lower growth and narrow private investment and consumption, as such increase deficit.

1.7 Within spending-based adjustments: the composition matters

Aiming to both reduce fiscal deficit and boost growth, fiscal consolidations will be logically, more and more, led by cut in government spending, given their efficiency. As such, an important question arises regarding the way of spending cut. Will be the level of reduction that matters (i.e. a proportional reduction of all spending categories) or the composition of the reduction (i.e. governments should cut some spending items more than others)? The answer to this question can be somewhere between "what is effective to do" and "what is exactly done" by governments. Regarding the effectiveness of fiscal contractions to stabilize deficit and have an expansionary effect, a great part of the literature highlights that current spending should be cut first during fiscal adjustment episodes. Alesina and Perotti (1995) contend that a decline in current spending would be correlated with a strong debt reduction whereas a cut in public investment would be associated with a low fiscal deficit contraction. In 1997 , the same authors reveal restrictive effects of consolidations led by investment cut and tax-based consolidations. Indeed, standard neoclassic approach sheds light on the existence of a wealth effect between income, leisure and labor supply within fiscal consolidations stances. Wealth effect takes place through the inverse relationship between income and labor. A rise in income without effort, such as transfers and subsidies, rises leisure and consumption demand to the cost of labor supply. In doing so, a reduction of agent income, through a cut in transfers and subsidies that come from governments, will lead to an increase of labor supply and as such to boost economy. However, a decrease in public investment adversely impacts total factor productivity and hinders economy development. This increases creditors pessimism and real interest rate as well as risk premium. All these consequences increase debt and lower the success probability of adjustment. Another mechanism puts forward to theoretically support the opposite view to investment bias is the weaken of unions power. Cut in public wages and/or employment increases the likelihood to be unemployed. A reduction of subsidies or unemployment allocations also increases the

cost of being unemployed. As private and public sector are complements in terms of employment, the reduction of public wages as well as transfers and subsidies negatively affect the utility to be members of union and shift public salaries to private sector with positive impact on economy. Consumption and investment will be boost and fiscal deficit will decline. Further, reduction of public transfers and subsidies allowed industrialized countries such as New Zealand to undertake reforms in the mid-eighties (Tanzi and Schuknecht, 1997).

1.8 Research questions

RESEARCH QUESTION N 1: WHAT IS THE EMPIRICAL TRADE-OFF IN THE COMPOSITION OF GOVERNMENT SPENDING DURING FISCAL CONSOLIDATIONS?

The previous section outlines the best scenario for governments to achieve strong fiscal deficit reduction and ensure economic growth during fiscal adjustments. However, what is the exact policy choice of governments? Spending-based fiscal consolidations can be done either by the reduction of public investment or public consumption, but the two strategies are not equivalent. While we know from the previous section that government consumption cuts likely to produce expansionary effects with strong reduction of deficit, one part of the literature outlines a possible different behavior of the government, due to political considerations. Some studies, in fact, push forward the "investment cut bias" concept during fiscal contractions. The idea is that governments reduce first public investment because cut in current expenditure such as wages and subsidies can entail to social unrest and political cost so that citizens will likely not reelect the government party. Indeed, Roubini and Sachs (1989) contend that governments tend to systematically cut public investment in the presence of budgetary constraints because it is the most flexible component of spending. Oxley and Martin (1991), using descriptive analysis of public finances in the 1970-1990 period, argue that the introduction of fiscal rules in OECD countries, aiming at cutting government spending, led to drastic reduction of public investment and increase in current expenditure.

Through a theoretical model in two periods, Balassone and Franco (1999) find that spending cut constraint leads governments to directly reduce public investment because actual government want to maximize the disposable income. This income is negatively correlated with lagged public investment. So, to reach its objective, government should minimize spending in capital. However, one of the first empirical studies that explicitly test this relationship was De Haan et al. (1996) one. These authors find a negative and significant impact of fiscal adjustment on government capital spending using 22 OECD countries over 1980-1992 period. A wide range of empirical and econometric papers follow the same path. Välilä and Mehrotra (2005) find that long run fiscal consolidations actions are linked to a downward trend of public investment. Out of OECD area, Jonakin and Stephens (1999) find an adverse impact of fiscal consolidations in 5 Latina America countries between 1975 and 1993. Under the pioneer work of Musgrave (1939), following by Creel et al. (2002) and Blanchard and Giavazzi (2004), the idea of bias against investment cut led to the implementation of public finance "golden rule". This rule aims to exclude public capital spending from the Stability Growth Pact (SGP) given its importance for growth.

Against this backdrop, my first research question reviews the relationship between fiscal consolidation and public spending composition with new approaches and insights including the direct impact on the ratio of the two main components of spending, the integration of persistence and size of adjustment as well as the heterogeneity of the impact following several economic considerations.

RESEARCH QUESTION N 2: IS THERE ANY RELATIONSHIP BETWEEN FISCAL CONSOLIDATIONS AND QUALITY OF PUBLIC SPENDING?

The first research question led to conclude that fiscal consolidations, almost always, reduce the public investment first and more drastically compared to current spending due to political considerations. This situation could have huge negative effects on the long-run output growth as well as development path. As such, fiscal consolidations could be considered

as very harmful for economy and likely lead to recessionary effects. However, several contributions highlight the fact that it is not the level of public investment that is important for growth, rather the quality of this investment matters. Indeed, Pritchett (2000), in its seminal paper, outlines that "every dollar spent by public sector as investment does not systematically turn into public capital and generate economic value". He explains that the traditional use of Cumulated Depreciated Investment Effort (CUDIE) to assess the impact of public capital on growth is wrong. Several factors hinder the ability of public investment to give full information on the evolution of public capital. First, it is difficult to measure and evaluate any flow in the single currency. Second, the evaluation of the cost of an infrastructure can be significantly different between countries. For instance, the construction of a motorway can be higher in the country A than in country B due to the lack of good project appraisal or there is not a competitive process to selection the constructor of the road in country A. This second argument represents in the much broader context the quality or efficiency in public investment management. Hulten (1996) provides evidence that the inefficient use of infrastructure leads to small returns on public investment. He finds that the output growth difference between Africa and East Asia countries is mainly due to efficiency use of resources. Caselli (2005), using the development accounting, finds that the efficiency is very important to explain the income differences across countries. While Dabla-Norris et al. (2012) develop a public investment management index (PIMI) to evaluate the quality of investment, Gupta et al. (2014) use the PIMI to construct an efficiency-adjusted capital stock before re-estimating the effects of public capital on growth.

Against this background, it appears important to investigate how fiscal consolidations, even reducing the amount of public investment, affect the efficiency of this important component of government spending. As such, this will lead to understand if fiscal contractions are really detrimental to growth through their impact on public capital or not.

RESEARCH QUESTION N 3: WHAT ARE THE IMPACTS OF FINANCING MODE ON PUBLIC INVESTMENT EFFICIENCY: THE CASE OF WAEMU?

One of the main reasons of fiscal consolidations is the accumulation of debt and unsustainable fiscal deficit. This deficit usually serves to finance short and long run projects such as investment programs. Sub-Saharan African countries, especially West African Economic and Monetary Union (WAEMU) States, have committed in huge investment programs to fill the crucial infrastructure gap. The share of investment in percentage of GDP rose from 4.0 to 9.8 % during 2005-2015 period. According to the International Monetary Fund (IMF), the States of WAEMU have a relatively low level of infrastructure development relative to some countries in sub-Saharan Africa such as Ghana, Kenya, Malawi and Rwanda, especially in energy, transport and telecommunications sectors. In a context of weak mobilization of fiscal resources, countries rely usually on expensive loans to finance their investments. This could lead to an increase in the budget deficit and debt, that is sharply increasing after the debt relief programs in 2011-2012. This increase in the budget deficit and debt could become problematic if public investment is not efficient enough to boost growth. In addition, the increasing use of debt, particularly on the regional market for public debt, could strongly impact the macroeconomic framework of the States of WAEMU, through the increase in sovereign risk which can weigh on financial stability. Under these circumstances, I investigate two important questions. First, it is important to gauge in what extent public investment is efficient in WAEMU zone relatively to peer countries. This will give us a good appreciation of the productive potential of these investments. Second, it appears crucial to estimate the impact of the financing sources on public investment efficiency. If it is unanimously acknowledged that most of the financing for public investment comes from debt, it is not however clear how the composition and the level of the debt impact the management of public investment. Further, this question increasingly paid attention due to the upturn trend of domestic debt in the WAEMU zone (Guérineau and Guillaumont, 2007).

RESEARCH QUESTION N 4: FISCAL MULTIPLIERS IN AFRICA USING FORECASTING MODELS?

My last research question encompasses the three previous ones under a consistent and global framework. So far, I outline how fiscal policy can impact growth through public investment efficiency and how financing sources can also stimulate economic activity through creating room for good public management. Above these different channels, fiscal policy can affect economic activity using other mechanisms. It is important to evaluate the ability of economy to turn public resources into economic prosperity with a general equilibrium approach. Since John Maynard Keynes in 1930s, this ability is well known as the fiscal multiplier of spending or taxes. The estimates of fiscal multiplier in the literature mainly rely on three approaches: Vector Autoregression models (VAR), narrative approach and dynamic stochastic general equilibrium (DSGE) models. DSGE models present two main advantages compared to others. First, these models include in their structure explicit micro-foundations, allow for model consistent expectations and provide a relative credible answer to the Lucas critique. Second, the shocks in DSGE, understood as the description of exogenous processes, provide direct economic interpretations compared to VAR models where there is need to identify exogenous shocks indirectly through reduced form residuals. Within DSGE models, the conventional wisdom relied either on neoclassical or Keynesian approach. Following Cogan et al. (2010), it seems important to hinge on a more elaborate framework to estimate the effects of the fiscal policy: The New Keynesian DSGE model, leading by the Smets and Wouters (2003, 2007) representation, reconciles the neoclassical and Keynesian approach. In addition, I choose to focus on African forecasting model because there is a little attention in the literature.

1.9 Contributions and outlines of thesis

This thesis investigates the macroeconomic impacts of fiscal policy, especially fiscal contractions and how they affect the performance of economy. **Chapter 2** analyzes the trade-off between public investment and consumption during fiscal consolidations. In response to increasing debt paths, governments often implement fiscal consolidation programs. This paper studies the impact of these programs on the composition of government spending. System-GMM estimations performed on a sample of 53 developed and emerging countries over 1980-2011 reveal that fiscal consolidations significantly reduce the government investment-to-consumption ratio, i.e. a *composition* effect. Robust to a wide set of tests, this significantly stronger contraction of government investment with respect to government consumption is at work particularly when debt is high, for spending-based fiscal consolidations, in the low phase of the economic cycle, and following debt and stock market crises. Therefore, in such contexts, fiscal consolidations aimed at short-run stabilization may hurt the economy in the long-run through their detrimental effect on public investment, calling for a reflection upon how they could be re-designed to allow avoiding such undesirable consequences.

However, it seems important to analyze the impact of fiscal consolidations on the productive part of public investment, capturing by its efficiency. **Chapter 3** then investigates the effect of fiscal consolidations on public investment efficiency. Drawing upon a "treatment effects" local projection Jordà and Taylor (2016) methodology and stochastic frontier analysis (SFA) à la Kumbhakar et al. (2015), we provide evidence of significant efficiency gains during fiscal consolidations periods on a sample of 53 developed and emerging countries over 1980-2011 period. The positive gain goes up to 5 years after the onset of fiscal programs with a cumulative improvement of about 4 percentage points at the end foresight horizon. Robust to a wide range of alternative specifications, huge public investment efficiency gains arise during economic slack, in emerging countries, with high perceived sovereign default risk as well as with the support of IMF programs. Moreover, the real depreciation policy improves the quality of public investment during fiscal consolidations periods. Our findings support the idea that fiscal consolidations, even reducing the level of public investment, may ensure

the long run economy development through better public management. Moreover, it is important to question what are the determinants of the improvement of the productive public capital, especially amongst the financing sources. Focusing on WAEMU zone, **Chapter 4** assesses the efficiency of public investment in West African Economic and Monetary Union (WAEMU) countries over 2006-2015 period, using Huang et al. (2014) stochastic Frontier Analysis (SFA) models. There is substantial difference between efficiency and effectiveness. While the first notion refers to the best way to use inputs to get outputs without wasteful, the second only assesses whether the predetermined outcomes are achieved with the given inputs. Efficiency can be split into managerial efficiency, related to good inputs management, and technological efficiency, related to production technology. The findings suggest that, at the global level, WAEMU countries are less efficient than Sub-Saharan African and Asian reference countries. However, the decomposition of global efficiency into managerial and technological, unveils that WAEMU countries are more efficient than Sub-Saharan African countries in terms of technological efficiency. Moreover, these findings are robust to non-parametric estimations. The assessment of financing sources denotes that external debt exerts more positive and significant effect on public investment efficiency than internal debt. Conditions related to external resources mobilization ensure their better management relatively to internal debt that comes from regional market bonds, where some governments use long run resources to finance current expenditure. Finally, we test the presence of fiscal multipliers and the ability of DSGE models to capture them in the context of African economy. **Chapter 5** develops a multi-sector dynamic stochastic general equilibrium (DSGE) model for a small open economy. The model is applied on South Africa and is designed to provide short-term forecasts and responses to various shocks of key macroeconomic variables for African countries. The results suggest that a 10 % increase in government purchases leads to a positive reaction of GDP up to 2 percentage points immediately affect the shock. This positive response lasts until 8 quarters after the shock. In other words, 1 % increase in government purchases lead to an increase in GDP by 0.2 %. These results are in line with the literature on New keynesian DSGE models.

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Chapter 2

The effects of fiscal consolidations on the composition of government spending [1]

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2.1 Introduction

To fight the detrimental effects of the recent financial crisis, many governments adopted large demand-based fiscal stimuli. Designed to boost economy activity, these policies resulted into large fiscal deficits and debt-to-GDP ratios. Given the danger on public finance sustainability, governments decided to implement fiscal consolidation programs.

There exists a large and increasing literature on fiscal consolidations. While surveying it is beyond the scope of this paper, important questions related to fiscal consolidations include: (i) the size of the fiscal consolidation episode, see e.g. Giavazzi and Pagano (1995) or Ardagna (2004); (ii) its persistence, see e.g. Drazen (1990), Heylen and Everaert (2000), or Barrios et al. (2010); (iii) its measure, usually based on observed variables such as the cyclically-adjusted primary balance, or on the narrative approach, see e.g. Alesina and Ardagna (1998); Alesina and Ardagna (2010); Cotis et al. (2004); Guajardo et al. (2014) for comparisons of alternative methods; and (iv) the variable that adjusts, namely spending or taxes. On this last point, Afonso and Jalles (2012); Alesina and Ardagna (1998); Alesina and Perotti (1995); McDermott and Wescott (1996), among others, found that successful fiscal consolidations mainly rely on expenditure cuts rather than tax increases, and e.g. Alesina and Ardagna (2013); Alesina et al. (2015, 2018); Heylen et al. (2013); Schaltegger and Feld (2009) conclude that fiscal consolidations led by spending cuts are more likely to generate growth and reduce deficits/debt than those led by tax hikes.

Consequently, focusing on public spending, several contributions investigated the component of public expenditure that should be cut in the process of fiscal consolidation. On the one hand, governments could reduce public investment, which is less effective for debt reduction (Alesina and Perotti, 1995) but politically more acceptable. However, the decline in public investment may hurt overall productivity (Aschauer, 1989), economic growth (Abiad et al., 2016), and welfare (Heijdra and Meijdam, 2002), to the point where, given the current global mild economic conditions, the IMF (2014, 2015) advocates for large public investment in infrastructure to sustain the global recovery after the crisis (echoing the 2014 "Juncker Plan" of the European Commission). On the other hand, governments could reduce current

spending, which are more efficient for deficit reduction but may affect governments' probability of reelection (Roubini and Sachs, 1989), and raise inequality and poverty (Agnello and Sousa, 2014).

Taking stock of these studies, the goal of this paper is to analyze the effect of fiscal consolidations on the composition of public spending. Despite being of particular importance, given the benefits and costs associated with reducing each type of public spending, this issue remains fairly unexplored with the notable exception of Castro (2017). Compared with Castro (2017), we draw upon Alesina and Ardagna (2013)'s novel measure of fiscal consolidations that accounts for the size and the persistence of the adjustment (instead of a dummy variable as a measure of fiscal consolidations, see also De Haan et al. (1996)[2]). In addition, while Castro (2017) looks at different components of government expenditure in 15 EU countries, we specifically focus on the government investment-to-consumption ratio to assess the relative change between them. Using the system-GMM estimator of Blundell and Bond (1998) that properly tackles endogeneity, our findings based on a large sample of 53 developed and emerging countries over the 1980-2011 period are as follows.

First, while we confirm that fiscal consolidations reduce both the government investment-to-GDP ratio (Balassone and Franco (1999); De Haan et al. (1996); Turrini (2004); Välilä and Mehrotra (2005))[3] and the government consumption-to-GDP ratio (Castro (2017))–a level effect, we reveal that the government investment-to-consumption ratio equally significantly declines–a *composition* effect. Consequently, government investment is found to decrease more than government consumption during fiscal consolidations.

Second, we investigate the robustness of this finding with respect to an important source of debate, namely the definition of fiscal consolidations. Moving away from Alesina and Ardagna (2013)'s definition (used in our baseline analysis), we consider different lengths of the period used to define a fiscal consolidation episode, as well as endogenous definitions of

[2]Alternatively, Oxley and Martin (1991) draw upon descriptive statistics.

[3]Following the pioneering work of Musgrave (1939), Blanchard and Giavazzi (2004), among others, defended the idea of a "golden rule" of public finance, for protecting public investment by excluding it from the accountancy of the Stability and Growth Pact (SGP) 3% deficit rule. For a theoretical analysis of the golden rule, see e.g. Minea and Villieu (2009).

fiscal consolidations following Yang et al. (2015). Estimations with these alternative measures confirm the existence of a composition effect, and this decline of the government investment-to-consumption ratio remains robust when further controlling for periods unrelated to fiscal consolidations, or for a wide set of additional control variables.

Third, we explore the sensitivity of the composition effect with respect to fiscal conditions, the overall state of the economy, and the presence of crises. Estimations show that fiscal consolidations significantly reduce the government investment-to-consumption ratio only in a context of high debt, when they are spending-based, and in the low phase of the economic cycle. Next, we find that the contraction of the government investment-to-consumption ratio can be up to four times higher in non-OECD compared with OECD countries following fiscal consolidations. Moreover, further estimations reveal that a composition effect is at work when fiscal consolidations occur after stock market crises and particularly after debt crises, while the ratio government investment-to-consumption is not significantly affected by fiscal consolidations taking place after banking, inflation, or currency crises.

Finally, we assess the effect of fiscal consolidations on the components of public spending. While the contraction of government investment is significantly stronger than that of public wages, and health government spending, fiscal consolidations are associated with a higher ratio of government investment to transfers & subsidies, suggesting a relatively stronger decline of the latter with respect to the former.

The paper is organized as follows. Section 2 discusses the measurement of fiscal consolidation episodes, Section 3 presents the data and the methodology, Section 4 reports the baseline results, Section 5 analyzes their robustness, Section 6 explores the sensitivity of our findings to various economic characteristics, Section 7 looks at the sub-components of government spending, and Section 8 concludes.

2.2 Identification of fiscal consolidation episodes

2.2.1 Fiscal impulse measurement

We define a discretionary fiscal consolidation episode following the cyclically-adjusted primary balance (CAPB) approach developed by Blanchard (1990), and adopted by Alesina and Perotti (1995; 1997) and Alesina and Ardagna(1998; 2013), which consists of extracting the discretionary part of fiscal variables, excluding interest payments. Following Alesina and Perotti (1995), we build the CAPB in two steps. First, we regress for each country revenues R_t and spending G_t (in ratio of GDP) on a linear time trend (TREND) and the unemployment rate U_t, to obtain the cyclically-adjusted revenues and spending (in ratio of GDP)

$$R_t = \alpha_0 + \beta_0 TREND + \gamma_0 U_t + \epsilon_t, \tag{2.1}$$

$$G_t = \alpha_1 + \beta_1 TREND + \gamma_1 U_t + u_t. \tag{2.2}$$

Using the estimated parameters we compute what would have been revenues and spending in time t if the unemployment rate has remained constant between t and $t-1$

$$R_t^*(U_{t-1}) = \hat{\alpha_0} + \hat{\beta_0} TREND + \hat{\gamma_0} U_{t-1}, \tag{2.3}$$

$$G_t^*(U_{t-1}) = \hat{\alpha_1} + \hat{\beta_1} TREND + \hat{\gamma_1} U_{t-1}. \tag{2.4}$$

Second, we construct the discretionary change in the fiscal balance as the difference between the cyclically-adjusted fiscal variables in year t, and their respective values in year $t-1$

$$CAPB_t = [R_t^* - R_{t-1}] - [G_t^* - G_{t-1}]. \tag{2.5}$$

2.2.2 Definition of fiscal consolidation episodes

There are several ways to define a fiscal consolidation episode, usually based on a threshold value related to the size or the persistence of the change in the fiscal policy (see (Yang et al.,

2015), for a summary of different definitions). We define our fiscal consolidation episode following Alesina and Ardagna (2013).

Definition 1. *A fiscal consolidation is either:*

(1) the value of the fiscal retrenchment over a 2-year period if the ratio CAPB/GDP improves each year, and the cumulative improvement is of at least 2 percentage points, or

(2) the value of the fiscal retrenchment over a 3-year or more period if the ratio CAPB/GDP improves each year, and the cumulative improvement is of at least 3 percentage points.

This definition has several merits. First, it uses the novel approach that includes both the size and the persistence in the assessment of fiscal consolidations, whereas the size refers to the amplitude (intensity) of the CAPB/GDP change, and the persistence captures the length of the adjustment. Considering both features can overcome the famous "stop-and-go" problem in the fiscal consolidations literature. Second, it ensures the comparability of our analysis with the recent literature on fiscal consolidations that widely draws upon this definition (see e.g. Alesina and Ardagna(2010; 2013); Leigh et al., 2010; Guajardo et al., 2014;Yang et al., 2015).

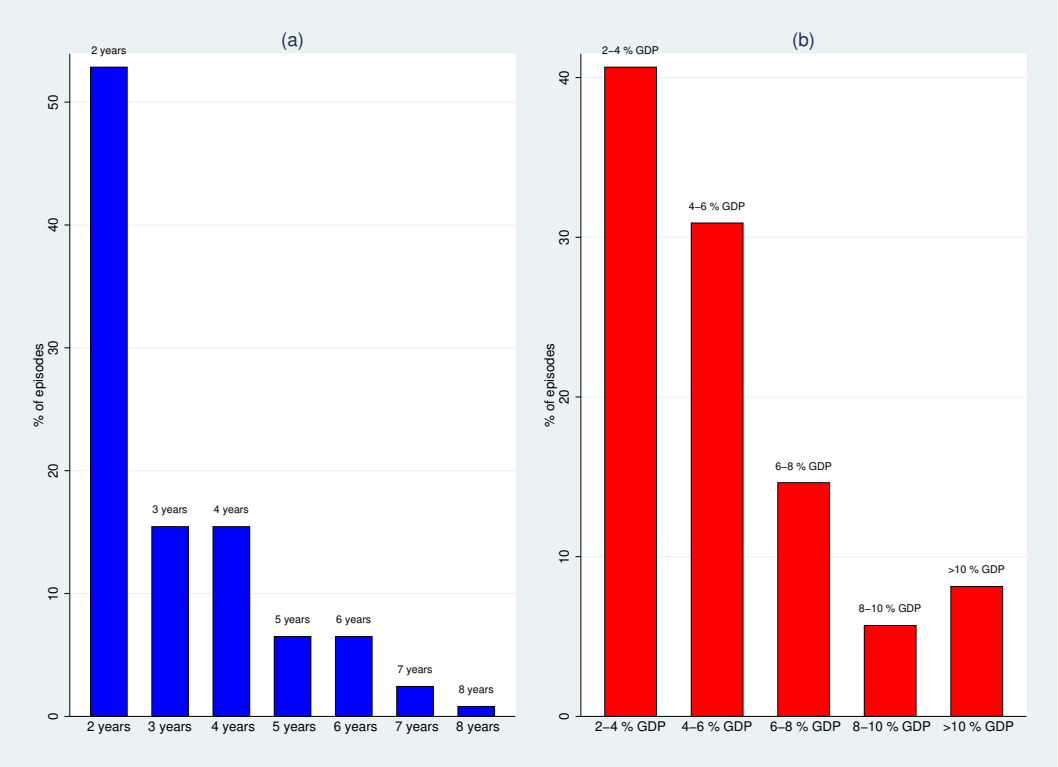
We identified 123 fiscal consolidation episodes during our considered period of 32 years. Figure 2.1 depicts the distribution of these episodes in percentage of the total number of fiscal consolidations in our sample, based on their size and persistence. Among them, 65 fiscal consolidations (52.85%) last 2 years, 19 (15.45%) last 3 years, and so on (see the Appendix for the list of fiscal consolidations); and 50 fiscal consolidations (40.65%) improve the fiscal balance between 2-4 percentage points of GDP, 38 (30.89%) between 4-6 percentage points of GDP, and so forth.

2.3 Data, and methodology

2.3.1 Data

Our study is performed in an unbalanced panel covering the period 1980-2011. Using Mauro et al. (2015) database, which provides the widest coverage of fiscal aggregates to our knowl-

Figure 2.1 – Distribution of the fiscal consolidation episodes by persistence and size



(a): the percentage of fiscal consolidations by length. (b): the percentage of fiscal consolidations by size.

edge, we obtained data for 56 developed and emerging countries. However, the need of unemployment data to build the CAPB forced us to exclude three countries, leading to a sample of 53 countries. We refrained from considering developing countries in our sample, given the high quality data on unemployment required by the computation of the CAPB.

Our dependent variables are government investment (GI), and government final consumption (GC). Government investment includes government expenditure devoted to fixed and durable goods, such as roads, energy, and telecommunications infrastructures (source: (IMF, 2017) database). According to the National Accounting System, government final consumption encompasses all current expenditure used for purchasing goods and services, excluding the military materials that are included in the government investment, but including compensation of employees and interest payments (source: WDI, 2016).

Control variables are those that can impact government spending, and may even affect

fiscal consolidations, namely: (i) debt ($DEBT$), (ii) real growth ($GROWTH$), (iii) trade openness ($TRADE$), (iv) private investment ($IPRIV$), (v) a dummy variable capturing the impact of being under an IMF program ($IMFP$), (vi) transfers & subsidies (SUB), and (vii) government stability (GOV); except for real growth and the IMF program dummy, all variables are in ratio of GDP. The Appendix reports the sources, definitions, and descriptive statistics of variables.

2.3.2 The econometric model

We estimate the following dynamic model with country-fixed effects

$$GI_{it} = \alpha_0 + \rho_0 GI_{it-1} + \beta_0 CONS_{it} + \beta_0^k X_{it}^k + v_i + \epsilon_{it}, \tag{2.6}$$

$$GC_{it} = \alpha_1 + \rho_1 GC_{it-1} + \beta_1 CONS_{it} + \beta_1^k X_{it}^k + \mu_i + u_{it}. \tag{2.7}$$

The dependent variable $GI_{it}(GC_{it})$ stands for government investment (consumption) in ratio of GDP, ρ accounts for inertia in the dynamics of GI or GC, β^k is the marginal effect of each of the k control variable, $v_i(\mu_i)$ are country-fixed effects, and $\epsilon_{it}(u_{it})$ is the error term. The coefficient of interest is β_0 (β_1), which captures the effect of our fiscal consolidation variable ($CONS$) on $GI_{it}(GC_{it})$.

We use the Blundell and Bond (1998) system-GMM estimator in our baseline model, for the following reasons. First, OLS lead to bias estimates, since they do not account for country-unobserved heterogeneity. However, the country-fixed effects estimator is also inconsistent when the time panel dimension is short, due to the correlation between the lagged dependent variable and the error terms (Nickell, 1981). Besides, Hauk and Wacziarg (2009) emphasize that the fixed-effects estimator worsens the bias related to measurement errors, and undervalues the impact of covariates in a dynamic panel setting with time-persistent regressors, as in our case. Second, while the difference-GMM estimator copes with the heterogeneity bias in the first-difference step and mitigates endogeneity issues, it suffers from a weak-instrument problem due to the weak correlation between lagged variables in

level and variables in first-difference in the presence of time-persistence (Alonso-Borrego and Arellano, 1999). Third, the system-GMM provides more consistent and efficient estimators than the difference-GMM in dynamic panels in the presence of highly-persistent variables over time ((Blundell and Bond, 1998) and (Blundell et al., 2001)). Finally, the system-GMM provides a smaller bias (in terms of size) than the difference-GMM or the fixed-effects estimators, even when the required stationary condition is doubtful (Hauk and Wacziarg, 2009).

2.4 Baseline results

Our baseline results are presented in Tables 1, 2, and 3. When implementing the system-GMM estimator, we overcome the proliferation of instruments by collapsing the matrix of instruments to have less instruments than countries (Roodman, 2009).[4] In addition to the strong effect of the lagged depending variable, the use of the system-GMM estimator is equally supported by usual diagnostic tests, namely valid instruments (see the p-value of the Hansen test), and the presence (absence) of first-order (second-order) autocorrelation in the dependent variable as shown by the AR(1) (AR(2)) test.

2.4.1 Level effects

According to Table 1, fiscal consolidations significantly decrease GI on average, even in the presence of different control variables. Analogously, fiscal consolidations equally significantly decrease GC on average, as shown by Table 2.[5]

It is then interesting to compare the effect of fiscal consolidations on GI and GC. As shown by Tables 1-2, fiscal consolidations are found to decrease both variables. However, concluding that these coefficients are statistically different (or not) is a fairly complicated

[4] In addition, we report that the variables are stationary (results are available upon request).

[5] Only few control variables are significant. For example, an increase in private investment sometimes reduces GI, but does not affect GC, suggesting that substitution effects between private and public investment may be at work. In addition, higher trade and economic growth are associated with a decrease in GC. Finally, the presence of an IMF program significantly reduces both GI and GC.

task, given that they are of comparable size (all the more if we take into account standard errors), and are extracted from different regressions. In addition, when estimating the effect of fiscal consolidations on GI (GC), we use GC (GI) ratio as a covariate, i.e. the impact of fiscal consolidations on government investment (consumption) is computed for a *given* level of government consumption (investment); as such, we capture a pure level effect, and cannot assess their relative change. To deal with this issue in a more appropriate manner, we look in the following at the composition effect of fiscal consolidations.

2.4.2 The *composition* effect: government investment *versus* government consumption

To evaluate the relative response of the two types of public spending, we modify equations (6)-(7) and look at the effect of fiscal consolidations on the ratio GI/GC

$$\frac{GI_{it}}{GC_{it}} = \alpha_2 + \rho_2 \frac{GI_{it-1}}{GC_{it-1}} + \beta_2 CONS_{it} + \beta_2^k X_{it}^k + \lambda_i + \xi_{it}, \tag{2.8}$$

with $\frac{GI_{it}}{GC_{it}}$ the ratio between government investment and consumption.

Table 3 presents the results. As shown by regression (1), fiscal consolidations significantly decrease the ratio GI/GC. Corroborated with the individual decline previously emphasized for GI and GC, it comes that the relative change in the government investment ratio is stronger than the relative change in the government consumption ratio.[6]

With respect to an early literature, which insisted on the fact that fiscal consolidations tend to reduce government investment (see e.g.Oxley and Martin (1991), or De Haan et al. (1996)), our findings suggest that government consumption is equally reduced following fiscal consolidations, consistent with the view that challenges its importance for the likelihood of

[6]This result can be intuitively supported as follows. The mean of the government investment ratio (4.13%) is roughly four times lower than the mean of the government consumption ratio (16.22%). Given that the negative effect is about two third for government investment compared with government consumption (see the coefficients of $CONS$ in the last column of Tables 1-2), the relative decrease of the GI seems stronger. However, what Table 3 adds, in particular, is that this decrease is significant. According to the last column of Table 3, an improvement of the CAPB of 1.70 percentage points of GDP (the average CAPB improvement during fiscal consolidations) reduces the GI/GC ratio by roughly 4 percentage points of GDP in the long-run.

Table 2.1 – The effect of fiscal consolidation on the government investment to GDP ratio

	(1) BB	(2) BB	(3) BB	(4) BB	(5) BB	(6) BB	(7) BB	(8) BB
GI_{it-1}	0.785***	0.871***	0.884***	0.774***	0.772***	0.647***	0.718***	0.770***
	(0.192)	(0.080)	(0.081)	(0.178)	(0.159)	(0.146)	(0.132)	(0.119)
$CONS_{it}$	-0.077**	-0.081***	-0.081***	-0.098***	-0.095***	-0.068*	-0.100***	-0.100***
	(0.036)	(0.028)	(0.030)	(0.034)	(0.028)	(0.037)	(0.032)	(0.024)
GC_{it}		-0.024	-0.028	-0.015	-0.012	0.017	-0.038	-0.052
		(0.036)	(0.034)	(0.049)	(0.047)	(0.062)	(0.049)	(0.041)
$DEBT_{it-1}$			-0.002	-0.003	-0.003	-0.003	-0.001	-0.001
			(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)
$GROWTH_{it}$				-0.051*	-0.049*	-0.035	-0.005	-0.004
				(0.030)	(0.028)	(0.030)	(0.013)	(0.012)
$TRADE_{it}$					-0.001	-0.009	-0.002	-0.001
					(0.004)	(0.013)	(0.003)	(0.003)
$IPRIV_{it}$						-0.020	-0.084**	-0.087**
						(0.073)	(0.038)	(0.034)
$IMFP_{it}$							-0.285*	-0.329**
							(0.169)	(0.153)
SUB_{it}							-0.006	-0.007
							(0.005)	(0.005)
GOV_{it}								0.009
								(0.011)
N	817	817	817	817	817	817	817	817
groups	43	43	43	43	43	43	43	43
N_instr	8	7	8	9	12	13	21	22
AR(1)	0.003	0.000	0.000	0.001	0.000	0.003	0.000	0.000
AR(2)	0.501	0.464	0.513	0.356	0.351	0.293	0.453	0.480
Hansen	0.130	0.129	0.146	0.286	0.549	0.445	0.707	0.815

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Lagged GI is predetermined, lagged debt is exogenous, and the remaining covariates are endogenous variables.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.2 – The effect of fiscal consolidation on the government consumption to GDP ratio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GC_{it-1}	0.893***	0.834***	0.836***	0.723***	0.845***	0.855***	0.840***	0.857***
	(0.049)	(0.063)	(0.058)	(0.058)	(0.064)	(0.062)	(0.049)	(0.039)
$CONS_{it}$	-0.182***	-0.173**	-0.181**	-0.103**	-0.136**	-0.137**	-0.167**	-0.159**
	(0.059)	(0.085)	(0.091)	(0.046)	(0.054)	(0.057)	(0.069)	(0.070)
GI_{it}		0.474*	0.444**	0.416*	0.333*	0.302*	0.317*	0.316**
		(0.261)	(0.225)	(0.232)	(0.171)	(0.163)	(0.178)	(0.152)
$DEBT_{it-1}$			0.004	0.009	0.001	0.000	-0.005	-0.001
			(0.008)	(0.010)	(0.007)	(0.008)	(0.008)	(0.013)
$GROWTH_{it}$				-0.128***	-0.087***	-0.081***	-0.088***	-0.096***
				(0.031)	(0.023)	(0.026)	(0.030)	(0.031)
$TRADE_{it}$					-0.028***	-0.028***	-0.020**	-0.025***
					(0.009)	(0.009)	(0.010)	(0.010)
$IPRIV_{it}$						-0.024	-0.048	-0.027
						(0.029)	(0.033)	(0.037)
$IMFP_{it}$							-0.518**	-0.456**
							(0.205)	(0.180)
SUB_{it}							-0.003*	-0.001
							(0.002)	(0.001)
GOV_{it}								0.032
								(0.028)
N	817	817	817	817	817	817	817	817
groups	43	43	43	43	43	43	43	43
N_instr	20	12	13	12	20	21	28	24
AR(1)	0.008	0.009	0.005	0.013	0.008	0.008	0.006	0.009
AR(2)	0.369	0.717	0.305	0.463	0.411	0.464	0.582	0.340
Hansen	0.508	0.177	0.169	0.521	0.280	0.261	0.219	0.327

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Lagged GC is predetermined, GDP growth and fiscal consolidation are endogenous, and the remaining covariates are exogenous.

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

Table 2.3 – The effect of fiscal consolidations on the GI/GC ratio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\frac{GI_{it-1}}{GC_{it-1}}$	0.884***	0.797***	0.805***	0.795***	0.797***	0.766***	0.766***
	(0.101)	(0.118)	(0.103)	(0.097)	(0.095)	(0.074)	(0.071)
$CONS_{it}$	-0.493**	-0.484***	-0.515***	-0.458***	-0.472***	-0.579***	-0.551***
	(0.200)	(0.176)	(0.165)	(0.146)	(0.141)	(0.166)	(0.192)
$DEBT_{it-1}$		-0.050**	-0.048***	-0.048***	-0.053***	-0.049***	-0.053***
		(0.021)	(0.016)	(0.017)	(0.013)	(0.018)	(0.020)
$GROWTH_{it}$			0.107*	0.100*	0.212***	0.184**	0.177**
			(0.055)	(0.052)	(0.071)	(0.083)	(0.087)
$TRADE_{it}$				-0.005	-0.014	0.007	0.007
				(0.020)	(0.017)	(0.022)	(0.023)
$IPRIV_{it}$					-0.307**	-0.257*	-0.270*
					(0.147)	(0.149)	(0.158)
$IMFP_{it}$						0.517	0.440
						(0.591)	(0.616)
$\frac{SUB_{it}}{GC_{it}}$						0.001	0.000
						(0.000)	(0.000)
GOV_{it}							-0.096
							(0.079)
N	817	817	817	817	817	817	817
groups	43	43	43	43	43	43	43
N_instr	8	9	12	15	20	24	25
AR(1)	0.000	0.001	0.000	0.000	0.001	0.000	0.000
AR(2)	0.510	0.570	0.612	0.621	0.529	0.612	0.609
Hansen	0.252	0.470	0.568	0.743	0.870	0.867	0.768

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Lagged GI/GC is predetermined, lagged debt, government stability and IMF program are exogenous, and the remaining covariates are endogenous.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

government's reelection (Peltzman (1992), Alesina et al. (1998)). However, the composition effect that we reveal suggests that fiscal consolidations lead to a more important cut in government investment than in government consumption.

2.5 Robustness

In this section we explore the robustness of our baseline results in several ways.

2.5.1 Alternative definitions of fiscal consolidations

In Alesina and Ardagna (2013)'s definition used to compute fiscal consolidations in the baseline specification, the threshold is somehow arbitrary. To check whether our findings are sensitive to a particular threshold, we consider the following alternative definitions of fiscal consolidations. First, compared with the baseline definition of 2 years & 2 percentage points

Table 2.4 – Fiscal consolidations and the GI/GC ratio: alternative definitions of thresholds

Alternatives	Threshold criteria		
	threshold 1	threshold 2	threshold 3
	(1)	(2)	(3)
$\frac{GI_{it-1}}{GC_{it-1}}$	0.790***(0.139)	0.789***(0.147)	0.738*** (0.179)
$CONS_{it}$	-0.390** (0.197)	-0.414** (0.194)	-0.432** (0.194)
N	1124	1124	1124
Groups	47	47	47
N_instr	18	18	22
AR(1)	0.001	0.001	0.004
AR(2)	0.570	0.576	0.609
Hansen	0.846	0.829	0.859
Controls	Yes	Yes	Yes

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Lagged GI/GC is predetermined, lagged debt, government stability and IMF program are exogenous, and the remaining covariates are endogenous. We introduce lagged debt, GDP growth, trade, private investment, IMF program and government stability as explanatory variables.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

(hereafter pp), or 3 years & 3 pp, we increase the threshold to stress the fact that the change

in fiscal policy is discretionary. With "threshold 1", a fiscal consolidation episode is signalled by either 2 years of consecutive CAPB improvement of at least 2.5 pp of GDP, or 3 years & 3.5 pp improvement; while for "threshold 2" ("threshold 3"), the corresponding numbers are 2 years & 3 pp (4 pp), or 3 years and 4 pp (5 pp). As shown by columns (1)-(3) in Table 2.4, using these different thresholds to define fiscal consolidations has little impact on their effect on the GI/GC ratio compared with our baseline results.

Second, since countries do not present the same deficit level or the same structural capacity to reduce it, we allow the threshold to vary with respect to the country-specific average (me) and standard deviation (sd) in CAPB changes. Following Yang et al. (2015), "def 1" designs a fiscal consolidation episode defined as: (i) a one-year fiscal consolidation, if the CAPB improvement is at least me+sd for this year, except if the CAPB falls by me+sd in the previous or next year; or (ii) a two-year (three-year or more) fiscal consolidation, if the CAPB improves in the first year by at least me+1/4sd and the cumulative improvement is of at least me+sd (me+3/2sd); and (iii) a fiscal consolidation stops if the CAPB does not improve in one year or improves by less than me+1/4sd, and the cumulative improvement over the following year is of at least me+1/4sd; however, the fiscal consolidation continues if the variation of the CAPB ranges between me+1/4sd and me-1/4sd in this year. Similarly, "def2" and "def3" use the multiples (3/4,1/4,1,3/2) and (2,3/4,2,3) of the standard deviation to construct alternative fiscal consolidations measures. As shown by columns (1)-(3) of Table 2.5, despite some magnitude loss, fiscal consolidations are still significantly related with a decrease in the GI/GC ratio.

Third, we further account for country-specific heterogeneities, and particularly for international trade shocks on fiscal policy, by including the terms of trade, in addition to the unemployment rate, when computing the CAPB. As such, a fiscal consolidation episode is signaled by: (i) a 2-year period in which the CAPB improves each year and the cumulative improvement is of at least 2*(me-sd) pp; or (ii) a 3-year or more period in which the CAPB improves each year and the cumulative improvement is of at least 3*(me-sd) pp. Despite a lower magnitude compared with the baseline, column (4) of Table 2.5 confirms yet again the

Table 2.5 – Fiscal consolidations and the GI/GC ratio: endogenous thresholds and an alternative consolidation measure

Altenatives	Endogenous threshold			CAPB concept
	Def1	Def2	Def3	Terms of Trade
	(1)	(2)	(3)	(4)
Single year	1	3/4	2	
Multiple years	1/4,1,3/2	1/4,1,3/2	3/4,2,3	
$\frac{GI_{it-1}}{GC_{it-1}}$	0.768***(0.031)	0.771***(0.036)	0.803*** (0.018)	0.746***(0.050)
$CONS_{it}$	-0.225*** (0.077)	-0.222***(0.079)	-0.181***(0.061)	-0.221**(0.072)
N	1124	1124	1124	1124
Groups	47	47	47	47
N_instr	26	26	30	19
AR(1)	0.000	0.000	0.000	0.000
AR(2)	0.538	0.544	0.571	0.572
Hansen	0.443	0.394	0.788	0.819
Controls	Yes	Yes	Yes	Yes

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Lagged GI/GC is predetermined, lagged debt, government stability and IMF program are exogenous, and the remaining covariates are endogenous. We introduce lagged debt, GDP growth, trade, private investment, IMF program and government stability as explanatory variables.

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

negative effect of fiscal consolidations on the GI/GC ratio.

2.5.2 A "Placebo-test" of fiscal consolidations

Our baseline specification includes only changes in the CAPB during fiscal consolidation episodes. Indeed, we assume that the effect of fiscal consolidations is specific, and not related to discretionary changes in fiscal policy during "normal" times. To take a closer look at this assumption, we introduce in equations (6)-(8) the change in CAPB during the periods of no fiscal consolidations ($NCONS_{it}$), following Alesina and Ardagna (2013). Results in Table 2.6 support our assumption, since the effect of $NCONS$ is mostly not significant. More importantly, we confirm the bias against public investment, since the effect of fiscal consolidations on the GI/GC ratio remains significant and negative.

Table 2.6 – The effect of fiscal consolidations on the GI/GC ratio: no consolidation episodes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\frac{GI_{it-1}}{GC_{it-1}}$	0.895***	0.939***	0.945***	0.931***	0.928***	0.931***	0.856***
	(0.176)	(0.106)	(0.087)	(0.088)	(0.106)	(0.089)	(0.164)
$CONS_{it}$	-0.439**	-0.488**	-0.405**	-0.363**	-0.393**	-0.354**	-0.395**
	(0.206)	(0.216)	(0.167)	(0.175)	(0.175)	(0.178)	(0.179)
$NCONS_{it}$	-0.162	-0.187	-0.184**	-0.166*	-0.155**	-0.134	-0.121
	(0.122)	(0.115)	(0.091)	(0.085)	(0.068)	(0.082)	(0.095)
N	1151	1151	1151	1151	1151	1151	1151
groups	48	48	48	48	48	48	48
N_instr	11	9	14	17	21	21	26
AR(1)	0.002	0.000	0.000	0.000	0.000	0.000	0.003
AR(2)	0.676	0.517	0.566	0.596	0.774	0.730	0.736
Hansen	0.451	0.489	0.676	0.781	0.853	0.867	0.839

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Starting from the most parsimonious specification (column 1), we progressively introduce lagged debt, GDP growth, trade, private investment, IMF program, and government stability in columns (2)-(7).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

2.5.3 Additional control variables

We introduce several additional control variables related to the financing of the economic development (foreign direct investment, and aid), to account for a crowding-in/out effect. In addition, we account for institutions (the political tendency of the government party, the political color of the legislature, and the electoral period), to control for potential partisan cycles. As shown by Table 2.17 in the Appendix, the negative effect of fiscal consolidations on the ratio GI/GC is still at work when controlling for these additional variables.

2.6 Heterogeneity

This section analyzes the sensitivity of the effect of fiscal consolidations on the GI/GC ratio with respect to fiscal conditions (the debt level, and the adjustment fiscal variable), the overall state of the economy (in the short-run: the position in the business cycle, and in the long-run: the development stage), and financial conditions (financial crises).

2.6.1 Fiscal conditions: the debt level, and the adjustment fiscal variable

First, fiscal consolidations are usually designed to reduce public debt. Consequently, it is appealing to see if their effect depends on the debt level. We use the median of the distribution of the average debt for each consolidation period (equal to 53%, in ratio of GDP) to differentiate between fiscal consolidations arising in high-debt ($CONS_{it}^{HD}$) and low-debt ($CONS_{it}^{LD}$) contexts. According to Table 2.7, fiscal consolidations significantly reduce the GI/GC ratio only in a context of high debt, consistent with previous findings of strong public investment contraction in damaged fiscal stance (see e.g. (Bacchiocchi et al., 2011)).

Second, fiscal consolidations can be performed through spending-cuts or tax-hikes (or a combination of the two). To see if the composition of the adjustment matters, we split fiscal consolidation episodes into "tax-based" adjustments ($CTAX_{it}$) for which most of the

Table 2.7 – The effect of fiscal consolidations on the GI/GC ratio: debt level sensitivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\frac{GI_{it-1}}{GC_{it-1}}$	0.974***	0.949***	0.940***	0.957***	0.950***	0.933***	0.937***	0.872***
	(0.161)	(0.118)	(0.107)	(0.081)	(0.057)	(0.061)	(0.066)	(0.063)
$CONS^{HD}$	-1.052***		-0.989***	-0.999***	-0.915***	-0.898***	-0.883***	-0.839***
	(0.297)		(0.260)	(0.239)	(0.241)	(0.231)	(0.235)	(0.290)
$CONS^{LD}$		0.007	0.002	0.058	0.077	0.131	0.133	0.060
		(0.209)	(0.210)	(0.200)	(0.180)	(0.195)	(0.198)	(0.175)
N	1180	1180	1180	1180	1180	1180	1180	1180
groups	48	48	48	48	48	48	48	48
N_instr	6	7	10	13	16	19	20	21
AR(1)	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.487	0.477	0.487	0.503	0.626	0.828	0.832	0.964
Hansen	0.620	0.277	0.546	0.567	0.616	0.574	0.563	0.739

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Starting from the most parsimonious specification (columns 1-3), we progressively introduce GDP growth, trade, private investment, IMF program, and government stability in columns (4)-(8).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

variation in the CAPB is due to tax hikes, and "spending-based" adjustments ($CSPEND_{it}$) for which most of the variation in the CAPB is due to a reduction in spending (McDermott and Wescott (1996), (Guajardo et al., 2014), or (Yang et al., 2015) equally use such a distinction). Table 2.8 shows that, once we account for most control variables (see from column 5 onwards), only fiscal consolidations based on spending-cuts robustly reduce the GI/GC ratio, suggesting that revenue-increasing strategies based on taxes may be a virtuous way to protect government investment.

2.6.2 The state of the economy

First, we consider the state of the economy in the short-run, captured by the phase of the business cycle. Drawing upon the popular Hodrick and Prescott (1997) filter to compute the cyclical component of GDP, we distinguish between "bad" times ($CONS_{it}^{LC}$) and "good" times ($CONS_{it}^{HC}$). As shown by Table 2.9, fiscal consolidations significantly reduce the GI/GC

Table 2.8 – The effect of fiscal consolidations on the GI/GC ratio: the adjustment variable

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\frac{GI_{it-1}}{GC_{it-1}}$	0.911***	0.899***	0.909***	0.898***	0.922***	0.919***	0.752***
	(0.063)	(0.038)	(0.060)	(0.042)	(0.037)	(0.041)	(0.059)
$CTAX_{it}$	-0.451***	-0.337**	-0.323	-0.278*	-0.220	-0.215	-0.140
	(0.152)	(0.143)	(0.349)	(0.167)	(0.223)	(0.193)	(0.146)
$CEXPD_{it}$	-0.572**	-0.505**	-0.429**	-0.459**	-0.489**	-0.405**	-0.452**
	(0.275)	(0.205)	(0.202)	(0.230)	(0.242)	(0.206)	(0.204)
N	1151	1151	1151	1151	1151	1151	1151
groups	48	48	48	48	48	48	48
N_instr	12	15	14	19	28	36	23
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.664	0.451	0.498	0.532	0.762	0.631	0.792
Hansen	0.619	0.743	0.475	0.672	0.564	0.385	0.669

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Starting from the most parsimonious specification (column 1), we progressively introduce lagged debt, GDP growth, trade, private investment, IMF program, and government stability in columns (2)-(7).

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

ratio only during bad times, corroborating to some extent our finding of a significant effect exclusively in high-debt contexts.

Table 2.9 – The effect of fiscal consolidations on GI/GC: the phase of the business cycle

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\frac{GI_{it-1}}{GC_{it-1}}$	0.942***	0.877***	0.958***	0.958***	0.929***	0.950***	0.957***	0.828***
	(0.140)	(0.197)	(0.063)	(0.067)	(0.053)	(0.086)	(0.082)	(0.056)
$CONS^{LC}$	-0.705***		-0.741***	-0.622**	-0.650**	-0.590**	-0.584**	-0.648***
	(0.266)		(0.273)	(0.292)	(0.277)	(0.266)	(0.264)	(0.215)
$CONS^{HC}$		-0.272	-0.335	-0.304	-0.355	-0.974	-0.895	-0.118
		(0.254)	(0.208)	(0.260)	(0.268)	(0.653)	(0.598)	(0.137)
N	1151	1151	1151	1151	1151	1151	1151	1151
groups	48	48	48	48	48	48	48	48
N_instr	7	8	11	14	15	28	29	22
AR(1)	0.001	0.004	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.649	0.655	0.461	0.442	0.543	0.770	0.766	0.735
Hansen	0.572	0.406	0.608	0.473	0.644	0.747	0.792	0.374

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Starting from the most parsimonious specification (columns 1-3), we progressively introduce GDP growth, trade, private investment, IMF program, and government stability in columns (4)-(8).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Second, we look at the state of the economy in the long-run, captured by the development stage. Despite most of the literature being devoted to developed countries, fiscal consolidations may impact differently the composition of public spending in OECD compared with non-OECD emerging countries, given the differences in their respective structural characteristics. Estimations reported in Table 2.10 show that this is indeed the case: although fiscal consolidations significantly reduce the GI/GC ratio in both OECD and non-OECD countries, the magnitude of the estimated coefficient can be up to four times higher in the latter group of countries (for example, if we compare columns 2 and 4). This may be related to a stronger political instability in non-OECD countries, making governments not to take electoral risks associated with cutting consumption spending.

Table 2.10 – The effect of fiscal consolidations on the GI/GC ratio: OECD vs non-OECD countries

	(1)	(2)	(3)	(4)
$\frac{GI_{it-1}}{GC_{it-1}}$	0.934***	0.895***	0.844***	0.776***
	(0.092)	(0.043)	(0.125)	(0.062)
$CONS_{it}$	-0.458**	-0.155***	-0.834**	-0.628**
	(0.229)	(0.055)	(0.349)	(0.257)
N	578	578	573	573
groups	21	21	27	27
N_instr	8	20	7	19
AR(1)	0.004	0.002	0.003	0.001
AR(2)	0.304	0.330	0.642	0.747
Hansen	0.536	0.250	0.468	0.745
Dvp. stage	OECD	OECD	Non-OECD	Non-OECD

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Starting from the most parsimonious specification (columns 1 and 3), we introduce lagged debt, GDP growth, trade, private investment, IMF program, and government stability in columns (2) and (4).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

2.6.3 Crises

In addition to the fiscal and economic conditions, the decision of governments to implement fiscal consolidations may be determined by the occurrence of crises. We consider five types of crises, namely debt, banking, inflation, currency, and stock market crises, and we are interested in fiscal consolidation episodes that occur between one and four years after the beginning of a crisis. Results reported in column (1) of Table 2.11 show that fiscal consolidations arising after a crisis significantly reduce the GI/GC ratio. This overall significant effect is driven by a significant effect of consolidations following stock market crises (column 6), and particularly debt crises (column 2). Indeed, debt and stock market crises put a high pressure on the fiscal balance and increase the risk of a systemic crisis; our results show that the required fiscal space is achieved by a stronger cut in public investment compared with public consumption. Finally, fiscal consolidations occurring after the beginning of banking, inflation, or currency crises were not found to significantly affect the GI/GC ratio, which may illustrate the fact that the policies required during these crises rest relatively less on government funds.

2.7 The sub-components of government spending

So far, we focused on aggregate government consumption (GC) and investment (GI) spending. We now investigate the effects of fiscal consolidations on more disaggregated government spending components, expressed in ratio of GDP. First, public wages ($WAGE$) measure the remuneration of public sector employees, and their consolidation may affect the welfare of the population. Second, transfers & subsidies (SUB) act as a distributional tool of national income, and their consolidation may affect population's living standards, and particularly the poor population. Third, health spending ($HEALTH$) are related to the healthcare system and social protection.[7]

Using these variables we look both at the level and the composition effect. Regarding the

[7]While education spending are a relevant component of government spending, we exclude them because they encompass both investment and current spending.

Table 2.11 – The effects of fiscal consolidations on the GI/GC ratio: crises

	(1)	(2)	(3)	(4)	(5)	(6)
$\frac{GI_{it-1}}{GC_{it-1}}$	0.811***	0.790***	0.932***	0.816***	0.817***	0.834***
	(0.179)	(0.053)	(0.085)	(0.108)	(0.129)	(0.075)
$CONS_{it}$	-0.419**					
	(0.196)					
$CONS^{DC}$		-0.952**				
		(0.464)				
$CONS^{BC}$			-0.116			
			(0.387)			
$CONS^{IC}$				0.159		
				(0.800)		
$CONS^{CC}$					0.071	
					(0.312)	
$CONS^{SM}$						-0.400**
						(0.197)
N	1151	1151	1151	1151	1151	1151
groups	48	48	48	48	48	48
N_instr	19	17	19	19	19	20
AR(1)	0.003	0.000	0.000	0.001	0.001	0.000
AR(2)	0.806	0.973	0.646	0.757	0.800	0.628
Hansen	0.685	0.566	0.327	0.599	0.474	0.397

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Lagged GI/GC is predetermined, lagged debt, government stability and IMF program are exogenous, and the remaining covariates are endogenous. $CONS^{DC}$, $CONS^{BC}$, $CONS^{IC}$, $CONS^{CC}$, and $CONS^{SM}$ design fiscal adjustments occurring within 1 to 4 years after the starting of sovereign debt, banking, inflation, currency, and stock market crises, respectively.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2.12 – The effect of fiscal consolidations on the GC sub-components (in GDP ratio)

	(1) $WAGE$	(2) SUB	(3) $HEALTH$
Dep_Var_{it-1}	0.533***	0.512***	0.917***
	(0.064)	(0.088)	(0.119)
$CONS_{it}$	0.124***	0.076	-0.102***
	(0.045)	(0.108)	(0.036)
N	437	437	437
groups	41	41	41
N_instr	30	24	33
AR(1)	0.061	0.026	0.001
AR(2)	0.614	0.507	0.353
Hansen	0.692	0.458	0.157

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Lagged Dep_Var_{t-1} is predetermined, lagged debt, government stability and IMF program are exogenous, and the remaining covariates are endogenous. For each sub-component, we also control by the other sub-components of government consumption.

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

Table 2.13 – The effect of fiscal consolidations on the ratio GI/GC-sub-components

	(1) GI_WAGE	(2) GI_SUB	(3) GI_HEALTH
$DepVar_{it-1}$	0.778***	0.490***	0.997***
	(0.098)	(0.013)	(0.017)
$CONS_{it}$	-0.864*	13.676**	-0.655**
	(0.479)	(6.804)	(0.273)
N	167	223	732
groups	17	17	48
N_instr	16	16	26
AR(1)	0.107	0.266	0.036
AR(2)	0.320	0.594	0.274
Hansen	0.312	0.681	0.318

Standard errors are in brackets. Regressions are based on the Blundell-Bond estimator. Lagged Dep_Var_{t-1} is predetermined, lagged debt, government stability and IMF program are exogenous, and the remaining covariates are endogenous.

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

level effect, Table 2.12 shows that the decrease of the GC ratio emphasized in our baseline analysis is mainly driven by the contraction of health. On the contrary, fiscal consolidations lead to an increase in public wages, while transfers & subsidies are not significantly affected. Regarding the composition effect, Table 2.13 shows that the decline in GI is stronger than the contraction of public wages, and health government spending, corroborating our previous results based on aggregate measures of GC. However, fiscal consolidations are found to increase the ratio between GI and transfers & subsidies, suggesting a strong decline of the latter, relatively more important than the decline of the former.

2.8 Conclusion

Existing studies emphasize a negative effect of fiscal consolidations on government investment and consumption as ratios of GDP (Balassone and Franco (1999); Castro (2017); De Haan et al. (1996); Turrini (2004); Välilä and Mehrotra (2005)). This paper looked at the effect of fiscal consolidations on the ratio between government investment and consumption. System-GMM estimations performed on a sample of 53 developed and emerging countries during the period 1980-2011 revealed that the contraction of government investment is more important than that of government consumption, i.e. a *composition* effect is at work, robust to a wide range of alternative specifications.

Given the large impact of both government consumption and investment on the economy documented by the existing literature, we investigated more in detail this composition effect. In particular, we found that public investment may be particularly affected by fiscal consolidations (i.e. its contraction may be stronger than that of public consumption) when debt is high, for spending-based fiscal consolidations, in the low phase of the economic cycle, and following debt and stock market crises. Consequently, our findings suggest that caution should be at work in such contexts, during which fiscal consolidations aimed at short-run stabilization may hurt the economy in the long-run through their detrimental effect on public investment. Future work could be devoted to exploring possible mechanisms in the design of fiscal consolidations that may allow avoiding such undesirable consequences.

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2.9 Appendix

Table 2.14 – Episodes of fiscal consolidations

Countries	Adjustment periods	number
Argentina	1984-1985; 1991-1993; 2002-2004	3
Australia	1983-1988; 1993-1997	2
Austria	1996-1997; 2000-2001	2
Belgium	1984-1987; 1993-1995	2
Bolivia	2003-2006	1
Brazil	1999-2000	1
Bulgaria	2000-2001; 2010-2011	2
Canada	1981-1982; 1990-1997	2
Chile	1987-1989; 1994-1995; 2003-2006; 2010-2011	4
China	2004-2007	1
Colombia	1985-1987; 2000-2001; 2003-2004	3
Costa Rica	1981-1982; 1991-1992; 1995-1997	3
Denmark	1983-1986; 2003-2005	2
Dominican Republic	2004-2007	1
Finland	1984-1985; 1988-1989; 1993-1994; 1996-1998	4
France	1994-1999 ; 2010-2011	2
Germany	1982-1985; 1996-2000; 2004-2007	3
Greece	1986-1987; 1990-1991; 2005-2006	3
Honduras	1985-1989, 1995-1996; 2003-2004	3
Hong kong	2006-2007; 2009-2010	2
Hungary	1999-2000; 2003-2004; 2007-2008	3
Iceland	1990-1992; 2004-2006	2
Indonesia	1989-1990	1
Iran	2003-2004	1
Ireland	1986-1989	1
Israel	1993-1995; 1997-2000; 2004-2007	3
Italy	1982-1983; 1988-1992; 1995-1997; 2006-2007	4
Japan	1981-1987	1
Mexico	1983-1984; 1986-1989	2
Netherlands	1981-1985; 2004-2006	2
New Zealand	1985-1988; 1992-1995; 2000-2005	3
Nicaragua	1991-1992; 1997-1998; 2010-2011	3
Norway	1981-1985; 1988-1990; 1993-1996; 1999-2000; 2004-2006	5
Pakistan	1988-1990 ;1993-1994; 1998-1999; 2006-2007	4
Panama	1985-1986; 1989-1990; 2005-2007	3
Paraguay	1985-1986; 1989-1990; 1993-1994; 2003-2004	4
Peru	1984-1985; 1988-1989; 2004-2007; 2010-2011	4
Portugal	1981-1984; 2002-2003; 2006-2007; 2010-2011	4
Romania	1997-1998; 2010-2011	2
Russia	2003-2005; 2010-2011	2
South Africa	1994-1995; 1998-1999; 2004-2007	3
South Korea	1995-2000	1
Spain	1983-1988; 2010-2011	2
Sweden	1981-1987; 1993-1998; 2004-2005	3
Switzerland	1992-1996; 2005-2006	2
Turkey	1981-1983; 1994-1995; 1998-1999; 2002-2005	4
United Kingdom	1981-1986 ; 1995-2000; 2010-2011	3
United States	1981-1982	1
Uruguay	1985-1986; 1990-1991; 2000-2005	3
Venezuela	2002-2005	1
	Total	123

Table 2.15 – Description of the variables

Variables	Descriptions	Sources
GI	Public investment in % of GDP	Authors' estimations based on (IMF, 2017)
GC	Current spending in % of GDP	Authors' estimations based on (IMF, 2017)
CONS	Change in CAPB in fiscal consolidation stance and zero otherwise	Authors' estimations
DEBT	Total debt in % of GDP	Mauro et al. (2015)
GROWTH	Real GDP growth rate	World Development Indicators
IPRIV	Private investment in % of GDP	(IMF, 2017)
FDI	Foreign direct investment in % of GDP	World Development Indicators
AID	Total aid in % of GNI	World Development Indicators
TRADE	Imports plus exports in % du GDP	World Development Indicators
EXECL	Dummy variable equal to 1 if it is a left-wing government and zero otherwise	World Development Indicators
PCOL	Dummy variable equal to 1 if legislature and government are led by different parties and zero otherwise	World Development Indicators
EXELEC	Dummy variable equal to 1 in the electoral period and zero otherwise	World Development Indicators
IMFP	Dummy variable equal to 1 if the country is under IMF program and zero otherwise	World Development Indicators
CONS_L	Interactive term between fiscal consolidations and the left-wing government dummy	Authors' estimations

Table 2.16 – Summary statistics

	count	mean	sd	min	max
GI	1455	4.1	2.5	0.2	21.9
GC	1333	16.2	4.8	3.0	43.5
GI/GC	1333	28.7	22.2	1.4	203.7
CONS	1393	0.5	1.1	0	13.5
DEBT	1438	54.9	32.6	4.1	231.0
GROWTH	1449	3.2	3.5	-13.4	18.3
TRADE	1340	63.4	31.7	11.5	190.1
IPRIV	1455	15.8	5.5	0.4	36.2
SUB	882	14.7	14.5	0	339.5
GOV	1312	7.8	1.8	1	12

Table 2.17 – The effect of fiscal consolidations on the GI/GC ratio: other controls

	(1)	(2)	(3)
$\frac{GI_{it-1}}{GC_{it-1}}$	0.907***	0.875***	0.759***
	(0.113)	(0.096)	(0.047)
$CONS_{it}$	-1.226***	-0.727***	-2.587*
	(0.341)	(0.220)	(1.441)
FDI	0.143		
	(0.297)		
AID		0.345**	
		(0.152)	
$DEBT_{it-1}$			0.016
			(0.015)
$PCOL$			-0.720
			(1.211)
$EXECL$			-1.606
			(1.927)
$EXELEC$			-1.926*
			(1.047)
$CONS\_L$			2.198
			(1.627)
N	328	328	328
groups	16	16	16
N_instr	12	8	12
AR(1)	0.014	0.015	0.009
AR(2)	0.102	0.103	0.178
Hansen	0.643	0.585	0.733

Standard errors in parentheses

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

Chapter 3

Does Fiscal Consolidation Improve Public Investment Efficiency ?

3.1 Introduction

The recent global financial 2007-09 turmoil has led, almost a decade after, to significant concern about the sustainability of public finances, with historically increase in debt ratios. (IMF, 2019)

Indeed, the recessionary effect related to this systemic crisis led governments to implement fiscal expansionary policy in order to attempt to boost growth and private consumption. Logically, this fiscal stimulus policy has increased debt and fiscal deficits.

Since 2010 however, and more accurately after the Greek crisis episode, policymakers understood the need to design credible strategies to clear their public finances and give good signal to financial markets. Thereby, fiscal consolidations programs were quickly designed and austerity packages have been implemented.

This situation has revived the interest of academics to revisit the impacts and main characteristics of fiscal adjustments, with a particular attention on their successful ability to reduce debt and their expansionary (or recessionary) effects on growth. Although there is not a consensus in the literature, most of the papers are aligned with the fact that composition of consolidations packages matters for the growth pace.[1]

In fact, Alesina et al. (2015, 2018); Yang et al. (2015), amongst others, support that spending based fiscal consolidations are associated with less output losses than tax based ones.

In addition, successful fiscal stabilizations appear to rely mainly on spending cuts rather than tax increases (Afonso and Jalles, 2012; Alesina and Ardagna, 1998; Heylen et al., 2013).

Focusing on public expenditure, many contributions go deeper into the composition of fiscal contractions packages to identify which component government should be cut first. Although current spending cuts, especially wage and transfers, have higher expansionary effects and strongly reduce deficit/debt (Alesina and Ardagna, 1998; Alesina and Perotti, 1995), governments mostly implement fiscal contractions through public investment cuts for political considerations (Balassone and Franco, 1999; Bamba et al., 2019; De Haan et al., 1996; Roubini

[1] Ramey (2019) surveys the recent development on fiscal multipliers estimates. While government spending multipliers are not above the unity, tax rate change multipliers range from -2 to -3. However, the magnitude of these estimates strongly depend on estimation methods, fiscal and country characteristics.

and Sachs, 1989).

At the first glance, decline in the public investment may lead to strong adverse impact on the economy. Indeed, several theoretical and empirical papers highlight the positive link between public infrastructure and economy development (Canning and Pedroni (1999); Demetriades and Mamuneas (2000); Esfahani and Ramirez-Giraldo (2003)).[2]

The cut in public investment may hurt economic growth (Abiad et al. (2016)), overall productivity (Aschauer (1989)), and welfare (Heijdra and Meijdam (2002)), to the point where, given the current global mild economic conditions, IMF (2014, 2015) advocate for large public investment in infrastructure to sustain the global recovery after the crisis (echoing the 2014 "Juncker Plan" of the European Commission). As such, fiscal consolidations aimed at short-run stabilization may hurt the economy in the long-run through their detrimental effect on public investment, calling for a reflection upon how they could be re-designed to allow avoiding such undesirable consequences.

However, another part of the story is worthy of attention. In fact, it seems that the great part of positive effects of public capital on economy growth stems from its quality rather than its quantity.

The starting point of this reflexion comes from the seminal paper of Pritchett (2000). The author questioned the large positive effects of public investment on growth, that has been found in the empirical studies. He outlines that the use of investment rate or Cumulated Depreciated Investment Effort (CUDIE) leads to overestimate the impact, because this indicator does not take the efficiency of public capital into account. Following Pritchett (2000), several contributions support this idea and provide theoretical and empirical evidence highlighting efficiency as a key determinant of social and economic impacts of public capital (IMF (2015); Gupta et al. (2014); Furceri and Li (2017)).[3]

In this paper, we attempt to shed light on the role of fiscal contractions in the constitution of productive public capital stock using 53 developed and emerging countries over 1980-2011 period. We investigate the effects of fiscal retrenchment on the efficiency of public

[2] Romp and Haan (2007) for the extended survey.

[3] They find that a higher investment efficiency induces larger impact of public investment on output.

investment. We contribute to the existing literature in several points.

First, we put in the limelight the link between fiscal consolidations and public investment efficiency at the macro level.[4]

Second, we expand the debate of expansionary or recessionary effects of fiscal consolidations by highlighting the efficiency channel. As recommended by the IMF (2019), governments should design growth-friendly fiscal stabilizations programs to reduce debt vulnerabilities and build buffers in case of a major recession. A positive impact of fiscal consolidations on the public investment efficiency may lead to an improvement of the productivity of public capital. An increase in efficiency can be understood as an optimal management and redistribution of public spending in strategic and growth-friendly sectors of the economy. Fiscal adjustment could then be growth friendly if it manages to improve public investment efficiency.

Third, we build a public investment efficiency index following the novel two step approach of Kumbhakar et al. (2015). This estimator provides more consistent and accurate score of efficiency while disentangling the efficiency score into the long and short run component.

Fourth, we use the Jordà and Taylor (2016) AIPW estimation method that combines an impact evaluation assessment and the local projection approach. The first advantage of this strategy is that we control for the allocation bias issue due to the no random assignment of fiscal adjustments episodes. The second advantage is the "double-robust" estimation, meaning that this estimator requires only that one model (between the treatment and outcome) has to be well specified. The third advantage relies on the local projection ability to compute time-varying, non linear and state dependent estimates using few restrictions with respect to other models.

Our baseline findings suggest that countries that experienced fiscal consolidations episodes

[4]There exists a literature on organizational slack concept and the advantages or disadvantages to have one. Slack refers to the presence of excess resources relatively to the normal efficient operation of an organization(e.g. Welbourne et al. (1999); George (2005); Sgourev and van Lent (2017)). In the government local level, the New Public Management (NPM) paradigm led policymakers to focus more on organizational efficiency and reduce excess capacity, that characterize inefficiency (Hood (1991); Pollitt et al. (2007); Diefenbach (2009); Overmans (2018)).
Our study departs from the previous literature by focusing on the macro level of public spending management during fiscal stress.

significantly improve their public investment efficiency over 5 years after the beginning of the shock. The magnitude of the average treatment effects ranges from 0.98 (for the year of adjustment) to 3.96 percentage points (5 years after the shock). These results are robust to various endogenous definitions of fiscal consolidations, to extension of treatment and outcome model, to alternative estimators for efficiency as well as alternative assumptions on propensity score. Moreover, we undertake an interesting exercise of sensitivity with respect to the fiscal conditions (perception of sovereign risk), the state dependence of economy (business cycle and development stage), the presence of IMF supported programs and the implementation of accommodative monetary policy (real depreciation and low policy interest rate). Fiscal consolidations boost the productivity of public capital more in the emerging countries, during the downward phase of the cycle, and with a high perceived sovereign default risk. In addition, we still gain in efficiency, through fiscal consolidations, under IMF supported programs and when government increases the competitiveness through real effective exchange rate depreciation.

The paper is organized as follows. Section 2 outlines theoretical aspects, Section 3 presents the measurement of fiscal consolidations and efficiency, Section 4 displays some stylized facts, Section 5 exposes our identification strategy, Section 6 reports the baseline results as well as robustness checks, Section 7 exhibits sensitivity tests and Section 8 concludes.

3.2 Theoretical considerations

3.2.1 Conception of efficiency in the macroeconomic context

The concept of efficiency is not new in microeconomics, as it is the conventional way to classify firms in terms of performance.

Referring to Farrell (1957), we understand economic (overall) efficiency through two main components: technical efficiency and allocative efficiency. The former is a ability to avoid waste in the production process. More specifically, technical efficiency highlights the level of firm production relatively to the production possibility frontier. The latter refers to an opti-

mal mix of inputs given their respective costs and the production technology. In other words, allocative efficiency reflects the ability to choose, amongst the technical efficient packages, the less cost one. As defined, efficiency can be interpreted as an input conserving orientation (input orientation) or an output augmenting orientation (output orientation).

While input-oriented measures gauge the potential reduction of inputs without altering the level of output, output-oriented efficiency measures estimate how much output can be increased with the same quantities of inputs. The estimation of efficiency can also take the scale of economies into account. We have then constant return to scale (CRS) and variable return to scale (VRS).[5]

Developed first in the management firm literature, efficiency concept gains momentum in the public sector debate pushed by the increasing feeling of public administration accountability and the following New Public Management (NPM) paradigm in the 80s. Several contributions arose in the local (Afonso and Fernandes (2008); Vanden Eeckaut et al. (1993); Worthington (2000)) and regional country level (Zhong et al. (2011)).

Increasingly, researchers try to assess public sector efficiency at the national level with cross sections comparisons between countries. Several papers provide international comparisons of public spending management in various economic sectors including education (Afonso and Aubyn (2006); Witte and López-Torres (2017)) and health (Grigoli and Kapsoli (2013); Schwellnus (2009)).

Government acts as a decision making unit (DMU) by producing public goods and services (outputs) using government spending (inputs). As such, the efficiency of government is a ability to produce the highest level of public goods using public expenditure while avoiding waste.

To measure the performance of public sector, several methods have been implemented with various preference following the sector.

As far as public investment is concerned, the literature on the measurement of efficiency is relatively new and growing.

Dabla-Norris et al. (2012) develop a public investment management index (PIMI) based on

[5]For more discussion, see Coelli et al. (2005).

four critical stages of the process of public investment decision namely the project appraisal, selection, implementation and evaluation.

Gupta et al. (2014), drawing upon the PIMI index, compute an efficiency-adjusted public capital stock to reflect the quality of public investment.

Moreover, IMF (2015) proposes the Public Investment Management Assessment (PIMA) that reinforces the PIMI by taking into account the macroeconomic framework of public investment decision such as fiscal rules, government component coordination, public-private partnership (PPP) monitoring as well as management of state-owned firms.

Regarding the efficiency frontier analysis method, Albino-War et al. (2014) use the data envelopment analysis (DEA) and free disposal hull (FDH) methods to compute public investment efficiency scores for Middle East and North Africa (MENA) and Caucasus and Central Asia (CCA) oil-exporting countries. They find that there is need to improve pubic investment management for these countries. The IMF (2015) uses also a non-parametric frontier analysis for over 100 advanced, emerging and low income developing countries. The comparison between the value of public capital (input) and measures of infrastructure coverage and quality (output) across countries reveals average inefficiencies in public investment processes of around 30 percent.

3.2.2 Transmission channels

Several transmission channels can support a potential impact of fiscal consolidations on public investment efficiency.

The first channel relies on the willingness of governments to ensure the long run growth of the economy.

Indeed, spending-based fiscal adjustments rely mainly on investment cuts instead of current spending reductions. The decrease in public investment may impact the development of private sector (both consumption and investment) as well as the long run output growth. With the limited fiscal space, the only way to preserve the growth path and achieve successful fiscal consolidations is to increase the productivity of public investment and in turn public

capital. Improvement of productivity requires better management of scarce resources and fully employment of economy capacity. This then leads to increase in efficiency.

The second channel refers to fiscal conditions around adjustments and the willingness of governments to convince creditors and markets of the credibility of deficit sustainability strategy. Indeed, fiscal consolidations arise most of the time with specific fiscal conditions such as high debt and deficit, low growth, etc. These conditions decrease the confidence and notation of the financial markets about the country, as well as increase the pessimism of creditors and perceived sovereign default risk. In contrast, successful and growth-friendly fiscal consolidations require credibility from governments to financial markets through providing evidence of the financial solvency of country. As demonstrated by Edwards (1985), the investment behavior gives a positive signal to markets actors through the reduction of sovereign bonds spreads. To be productive, investments should have high quality both in terms of implementation and management.
In other words, the improvement of quality of public capital reduces the pessimism of creditors and contribute to lessen the perception of the sovereign risk. At the end, governments will increase public investment efficiency during fiscal consolidation programs in order to mitigate the pessimism of creditors and increase the likelihood of success of this program.

The third channel hinges upon the presence of international organizations programs such IMF supported programs during fiscal consolidations periods. As highlighted by the IEO (2003), IMF programs induce a large part of fiscal adjustment targets. These programs include some conditionalities and technical assistance (as well as training). More precisely, revenue mobilization and/or spending management are some examples of conditionality (Crivelli and Gupta (2016); Gupta et al. (2018)). These conditionalities lead governments to engage in structural reforms to strengthen the efficiency of public sector.
Through training and technical assistance, IMF can encourage key reforms by raise awareness of the newest developments in the academic and policy discussion as well as of the best practices internationally.
All in All, fiscal consolidations, in presence of conditionalities from international institutions,

may lead to improve public investment efficiency.

3.3 Identification of fiscal consolidations and efficiency score

3.3.1 Fiscal consolidations

The main concern when computing the fiscal consolidations episodes is to manage to proper identify the discretionary part in the policymakers decisions. While the first strand of the literature identifies discretionary fiscal actions by removing statistically the part of fiscal policy that are related to business cycle, the second strand puts forward the narrative approach that consists to review the budget and legislature documents in order to extract the discretionary part of fiscal policy.

Although the narrative approach is increasingly used in the literature (Devries et al. (2011); Guajardo et al. (2014), amongst others), this method is not exempt for serious and fundamental criticisms.

First, Guajardo et al. (2014) admit that fiscal impulse measurement remains biased whether the countries delay their fiscal consolidations till the economic conditions are favorable or reinforce it whether the growth path does not allow to achieve the targeted deficit reduction. Moreover, narrative-based fiscal shocks ignore anticipation effects.

Second, and more problematic, Jordà and Taylor (2016) shed light on the predictability of fiscal consolidations episodes by omitted fiscal variables, even after using the narrative approach as instrument. Following Alesina and Ardagna (1998, 2013) and Bamba et al. (2019), we use the cyclical-adjusted primary balance (capb) that belongs to the first category, to deal with our identification concern.[6] This strategy consists of extracting the discretionary part of fiscal variables, excluding interest payments. Following Alesina and Ardagna (1998), we build the CAPB in two steps. First, we regress revenues R_t and spending G_t (in ratio of

[6]We also use in the second stage Jordà and Taylor (2016) approach to deal with the endogeneity and allocation bias issues.

GDP) on a linear time trend (TREND) and the unemployment rate U_t, for each country, to obtain the cyclically-adjusted revenues and spending (in ratio of GDP)

$$R_t = \alpha_0 + \beta_0 TREND + \gamma_0 U_t + \epsilon_t, \tag{3.1}$$

$$G_t = \alpha_1 + \beta_1 TREND + \gamma_1 U_t + u_t. \tag{3.2}$$

Using the estimated parameters, we compute what would have been revenues and spending in time t if the unemployment rate has remained constant between t and $t-1$

$$R_t^*(U_{t-1}) = \hat{\alpha_0} + \hat{\beta}_0 TREND + \hat{\gamma_0} U_{t-1}, \tag{3.3}$$

$$G_t^*(U_{t-1}) = \hat{\alpha_1} + \hat{\beta}_1 TREND + \hat{\gamma_1} U_{t-1}. \tag{3.4}$$

Second, we construct the discretionary change in the fiscal balance as the difference between the cyclically-adjusted fiscal variables in year t, and their respective values in year $t-1$

$$CAPB_t = [R_t^* - R_{t-1}] - [G_t^* - G_{t-1}]. \tag{3.5}$$

Once we estimate the CAPB, we use an ad-hoc threshold and multi-year definition of fiscal adjustment episode following Alesina and Ardagna (2013):

Definition 2. *A fiscal consolidation is either:*

(1) the value of the fiscal retrenchment over a 2-year period if the ratio CAPB/GDP improves each year, and the cumulative improvement is of at least 2 percentage points, or

(2) the value of the fiscal retrenchment over a 3-year or more period if the ratio CAPB/GDP improves each year, and the cumulative improvement is of at least 3 percentage points.

This definition has several merits. First, it uses the novel approach that includes both the size and the persistence in the assessment of fiscal consolidations, whereas the size refers to the amplitude (intensity) of the CAPB/GDP change, and the persistence captures the length of the adjustment. Considering both features can overcome the famous "stop-and-

go" problem in the fiscal consolidations literature. Second, it ensures the comparability of our analysis with the recent literature on fiscal consolidations that widely draws upon this definition (see e.g.Alesina and Ardagna(2010; 2013); Leigh et al., 2010; Guajardo et al., 2014;Yang et al., 2015).

3.3.2 Efficiency score

In the same vein of the recent literature in the quality of public investment (Albino-War et al. (2014); IMF (2015); Barhoumi et al. (2018)), we estimate our efficiency score using the efficiency frontier analysis.[7]

However, our approach differs to them insofar as we opt for the parametric method, namely the Stochastic Frontier Analysis (SFA), rather the non-parametric one.[8] Several reasons motivate our strategy. First, The non-parametric techniques, especially the DEA and FDH (that are widely used), rely on linear optimization programs to build a convex curve that designs the efficiency frontier. As deterministic method, they ignore the random variation in the data, measurement error and any stochastic influence. In other words, this approach considers all variations between units as inefficiency (Kumbhakar and Lovell (2000)). This latter assumption is not fully true, especially in the relationship between between public outcomes and government spending. The level of public spending is not the only factor that determines the level of delivered outcomes in most of public services (education, health, investment,etc.). In the specific case of public investment, some unanticipated and noise shocks such as fall in oil prices, political crises, etc. may influence the way that governments will provide public infrastructure independently of their "true" inefficiency. As such, for the

[7]It is noteworthy that we are more interested in the technical efficiency than allocative efficiency. First, our aim is to gauge the capacity of policymakers to put "the right coin to the right place with the right way". We are convinced that the technical efficiency fits this objective. Second, the estimate of allocative efficiency requires information on price structure of inputs. Evaluate the prices public sector input seems to be a very complicated task due to the feature of input and inconsistence of price information across countries.

[8]The efficiency frontier approach relies on the computation of the production frontier curve that represents the highest output level reachable using a given set of inputs. This curve materializes the technical efficiency frontier. All DMU on the frontier are technically full efficients and the distance between a unit and the curve is a measure of inefficiency. The efficiency frontier can be estimated through parametric or non-parametric methods.

same amount of public investment, country A, which suffers from the unexpected shocks, will have systematically a low public infrastructure output than country B. It will inappropriate to interpret this "bad luck" as inefficiency. Fortunately, SFA allows us to disentangle the inefficiency arising from differences in socioeconomic contexts or "bad luck" from the right efficiency related to bad public sector management. Second, deterministic approach is very sensitive to the presence of outliers, sample size and in the case of heterogeneous units (Elisabetta et al. (2006)). We cover a wide range of developed and emerging countries over substantial large period. The level of public investment as well as its determinants may vary significantly across countries. SFA allows a regression-based approach to control these specificities.

Estimation process

We estimate our public investment efficiency score following the novel Kumbhakar et al. (2015) methodology. We consider the following model :

$$y_{it} = \alpha_0 + \beta x_{it} + \alpha_i + v_{it} - u_{it}^{+} - \eta_i^{+} \tag{3.6}$$

where y_{it} represents the log of the output variable and x_{it} denotes the vector of the input variables (log). While i and t design the country and the time, the superscript $(+)$ refers to the non-negative value of the corresponding component.

α_i, v_{it}, u_{it}^{+}, and η_i^{+} represent each one a specific component of the error term ϵ_{it}. α_i captures the country-specific effects (country heterogeneity), v_{it} materializes the pure noise term (iid). While u_{it}^{+} denotes the transient (short-run) technical inefficiency term, η_i^{+} represents the persistent (long-run) inefficiency component. α_0 is a constant.

The use of the Kumbhakar et al. (2015) estimator is suitable in our case for several reasons.

First, it controls for the unobserved heterogeneity between decisions making units and separate them to the inefficiency, contrary to most of the popular panel models (Battese and Coelli (1992); Kumbhakar (1991); Lee and Schmidt (1993)). Especially in the panel cross-country

analysis, heterogeneous characteristics of countries regarding their economic development, their political situations, etc. may influence the public infrastructure provision without reflecting a bad or good public management.

Second, and most relevant, Kumbhakar et al. (2015) approach provides an interesting and more flexible decomposition of the overall inefficiency (U_{it}) into the short-term - time-varying (u_{it}^{+}) and long-term - time-invariant- (η_{i}^{+}) technical inefficiency term. Even when the previous models separate heterogeneity unit effects (fixed or random) from inefficiency (Greene (2005); Kumbhakar and Wang (2005)); none of them makes a slight distinction between a short-run and a long-run the inefficiency term.

The distinction between transient and persistent inefficiency is very relevant for several reasons. Although the improvement of public investment management (efficiency) is considering as time invariant due to the fact that structural reforms implementation are long lasting (Dabla-Norris et al. (2012); Gupta et al. (2014)), there is a substantial part of this management that is likely to evolve over time.

In a microeconomic units context for instance, if we assume that a hospital has an inefficiency due to an excess capacity (more physicians and nurse that we need). The management can decide to re-allocate the personnel into different activities in order that part of the physicians' and nurses' daily working hours are employed in day hospital activities rather than being partially under-utilized in a full-time job allocation to acute discharges. This simply reallocation process may increase the labor productivity of hospital and dealt with a short run part of inefficiency (Colombi et al. (2011)).

In the same way, policymakers are able to reallocate the investment intentions amongst the different sectors of economy. This reallocation process is not time consuming and can improve the short-run part of efficiency. For the same amount, governments will increase the productivity of global investment by more investing in high growth friendly sectors such as transport and infrastructure sectors. In addition, there are evidence that the institutional context can influence the return on investment and its growth dividends (Esfahani and Ramirez-Giraldo (2003)). However, several institutional indicators, including the Country

Policy and Institutional Assessment (CPIA) index, provide evidence of a time-varying improvement of management framework across countries. This may then impact the efficiency of public investment in the short term.

The estimator requires two stage estimations. For this purpose, we rewrite equation (3.6) as follows:

$$y_{it} = \alpha_0^* + \beta x_{it} + \theta_i + \gamma_{it} \tag{3.7}$$

with

$$\alpha_0^* = \alpha_0 - E(\eta_i) - E(u_{it}) \tag{3.8}$$

$$\theta_i = \alpha_i - \eta_i + E(\eta_i) \tag{3.9}$$

$$\gamma_{it} = v_{it} - u_{it} + E(u_{it}) \tag{3.10}$$

First, we estimate equation (3.7) with a standard random effects estimator. We get consistent estimate of β as well as predicted values of θ_i and γ_{it}, denoted $\hat{\theta}_i$ and $\hat{\gamma_{it}}$. [9]

Second, we estimate equation (3.9) (equation (3.10)) following a standard stochastic frontier method in order to get the transient (persistent) technical inefficiency, $\hat{u_{it}}$ ($\hat{\eta_i}$). [10]

Finally, we compute the time-varying technical efficiency, $RTE = exp(-\hat{u_{it}})$, as well as the persistent technical efficiency, $PTE = exp(-\hat{\eta_i})$ following (Jondrow et al. (1982)) process.

Output - Input

As mentioned above, the estimation of frontier analysis requires to specify at least one input and one output. In the public sector context, an output can be understood as measurable

[9] We assume that $\theta_i = \hat{\theta}_i$ and $\gamma_{it} = \hat{\gamma_{it}}$ as it is common in the two-stage estimations.

[10] We assume that $v_{it} \rightsquigarrow N(0, \sigma_v^2)$; $u_{it} \rightsquigarrow N^+(0, \sigma^2)$; $\eta_i \rightsquigarrow N^+(0, \sigma_\eta^2)$; and $\alpha_i \rightsquigarrow N(0, \sigma_\alpha^2)$. We predict the technical inefficiency components using the Jondrow et al. (1982) estimators.

variable that reflects the performance or the achievement of government in a specific sector. For example in public education sector, the output refers to student's performance such as graduation rates, and student mathematical, reading and scientific literature indicators.[11] Public investment is used to provide infrastructure in several economic sectors such as transport, energy, telecommunication, etc. In doing so, we need to find a multi-dimensional index output that can encompass and evaluate the performance of public spending in these different aspects. Albino-War et al. (2014) use the infrastructure part of the Global Competitiveness Indicator (GCI), developed by the World Economic Forum (WEF), as output to gauge the efficiency of public investment. However, this index does not fully reflect the performance of public investment as it is not possible to disentangle the public infrastructure from the private infrastructure. IMF (2015) slightly departs from the Albino-War et al. (2014) output by adding another physical composite indicator of infrastructure. This index includes some pure infrastructure indicators (electricity production, access to an improved water source and length of road network) and social services indicators (number of secondary teachers and number of hospital beds). However, the aggregation technique of the sub-components of this index relies on a simple arithmetic mean.[12] Although the assignment of equal weights to distinct dimensions of infrastructure is convenient, it may arise a conceptual issue.

Several papers relax this assumption and propose different aggregation methods for infrastructure based on statistical models (Calderón and Servén (2004, 2014); Francois and Manchin (2013)).

Following Donaubauer et al. (2016a,b); Kaufmann et al. (2011), we compute a global infrastructure index using the Unobserved Component Method (UCM). This approach interprets each sub component of infrastructure index as an imperfect measure of the underlying and unobserved notion of infrastructure. This interpretation turns the aggregation concern into a signal extraction problem. To solve this problem, the UCM approach models each subcomponent as a linear function of the common unobserved component of infrastructure with

[11] Several papers use the PISA indicators in OCED studies while educational attainment ratio is used in development and emerging countries studies (Clements (2002); Gupta and Verhoeven (2001)).

[12] $y_i = \Sigma_{j=1}^{4}\left(\frac{x_{ij}-\bar{x}_j}{\sigma_{x_j}}\right)$ where represents the sub-index j for the country i; $\bar{x}_j$ σ_{x_j} denotes the mean and the standard error of sub-index j respectively.

a disturbance term that designs perception errors and sampling variation.[13] As explained by Donaubauer et al. (2016b), there are several advantages to use UCM approach. First, compared to Principal Components Analysis (PCA), this method is robust to the unbalanced panel structure and the presence of outliers. Second, in the case of low correlation between the quantity and quality index, as it may be the case, the PCA is inappropriate to draw sufficient common factors between sub-components of infrastructure. Third, the unobserved indicator of infrastructure is expected to be more informative and precise about the infrastructure quality and quantity than any single index. We use 6 sub-index of infrastructure classified into 3 main groups:

-*Transport*: we use as quantitative indicator the length of road network, normalized by the density of population. For the quality of road, we use also the ratio of paved roads to total road network.

-*Telecommunications*: we select the fixed telephone subscriptions and the faults per 100 fixed telephone lines per year.

-*Energy* : we use the electric power consumption per capita, as quantity, and the electric power transmission and distribution losses in percentage of output as the quality of energy.

After computing the output of public infrastructure, we present our selected inputs for the frontier estimation.

The first input is the government capital stock in percentage of GDP. This variable stems from the IMF database and is based on the perpetual inventory method.

The second input is the stock of public-private partnership in percentage of GDP. This variable captures the increasing number of public private partnership project in may countries.

The third output is the GDP per capita that control for the quality of infrastructure that is lead by the development stage. We introduce all input variables with a one lag period to mitigate the endogeneity.

[13] See Donaubauer et al. (2016b) and Kaufmann et al. (2011) for the comprehensive and extended explanation of the process.

3.4 Data and preliminaries

3.4.1 Data

We use an unbalanced panel over the 1980-2011 period. The selection of our 53 developed and emerging countries relies essentially on the availability of data to compute the CAPB. We use the Mauro et al. (2015) database that provides, to our knowledge, the widest coverage of fiscal aggregates. We do not include developing countries in our sample due to the need of high quality data on unemployment to build the CAPB.

Our treatment variable is the fiscal consolidation variable dummy that takes 1 during the consolidation episodes and 0 otherwise. The construction process of this variable has been detailed above.

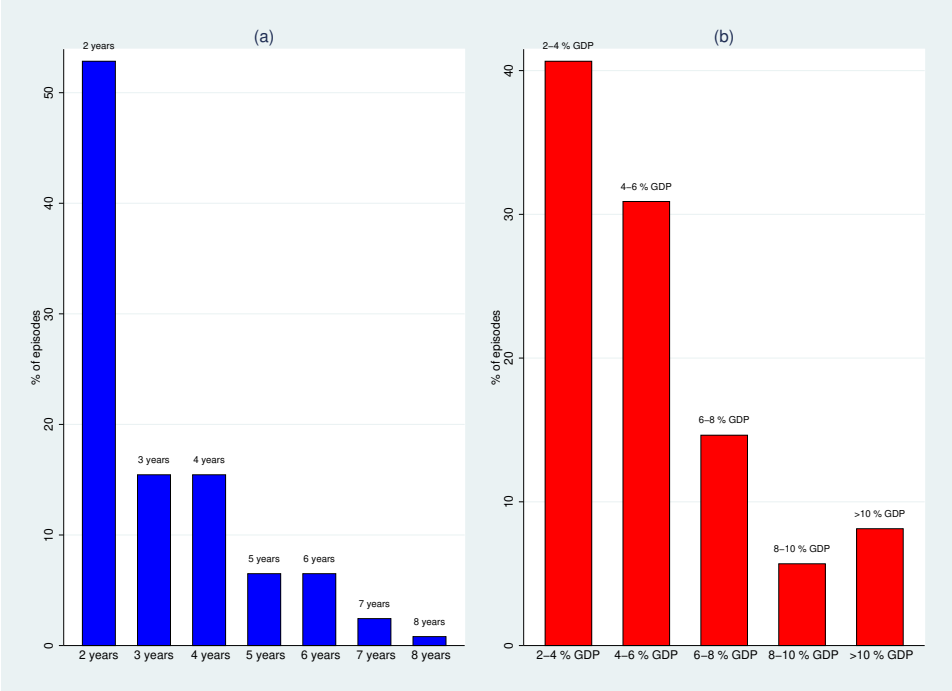
Our outcome variable is the time-varying technical efficiency of public investment. We focus on the transient part of the efficiency as we are interested in the short-run impact of fiscal consolidation instances on the more flexible part of public investment management.

Two groups of covariates are considered for our analysis. The first group is related to the treatment model and is used to predict the likelihood of experiencing a fiscal consolidation, namely: (i) the cyclical part of the log of real GDP, (ii) the revenue to GDP ratio, (iii) the expenditure to GDP ratio, (iv) the GDP growth rate, (v) debt to GDP ratio, (vi) the real interest rate; (vii) the balance current account; (viii) the total investment; (ix) the national savings; (x) the trade openness, and (xi) the foreign direct investment (fdi). Apart from real interest rate, all variables are in percentage of GDP. The predictors are one year lagged. The second group of control variables is used in the outcome model to predict the change in the efficiency at each horizon h. This group includes : (i) the one and two years lagged change of the public efficiency before the beginning of fiscal consolidations, (ii) a time trend, (iii) the quality of government, and (iv) the investment profile.

3.4.2 Descriptive statistics

We identified 123 fiscal consolidation episodes during our considered period of 32 years. Figure 3.1 depicts the distribution of these episodes in percentage of the total number of fiscal consolidations in our sample, based on their size and persistence. Among them, 65 fiscal consolidations (52.85%) last 2 years, 19 (15.45%) last 3 years, and so on (see the Appendix for the list of fiscal consolidations); and 50 fiscal consolidations (40.65%) improve the fiscal balance between 2-4 percentage points of GDP, 38 (30.89%) between 4-6 percentage points of GDP, and so forth.

Figure 3.1 – Distribution of the fiscal consolidation episodes by persistence and size

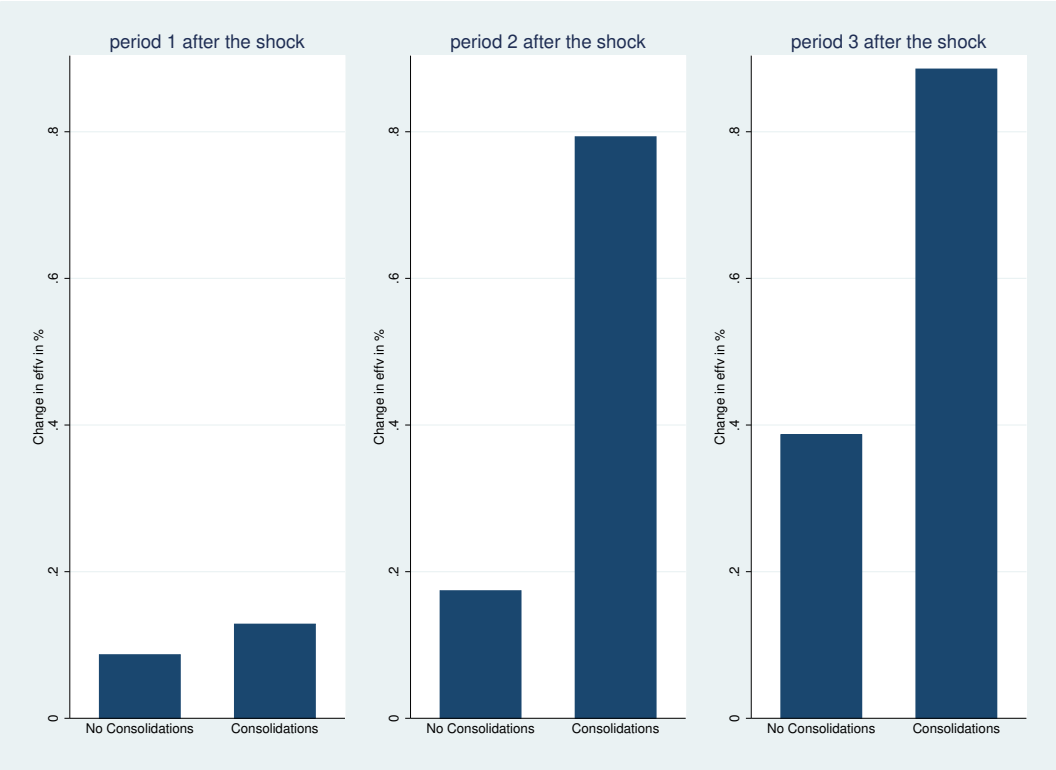


(a): the percentage of fiscal consolidations by length. (b): the percentage of fiscal consolidations by size.

Prior to begin the econometric analysis, we compare the cumulative change of efficiency with and without consolidations episodes. Figure (3.2) displays the means comparisons after 1, 2 and 3 year of the onset of the consolidations instances. Stylized facts presented in figure (3.2) highlight a high level of efficiency in the fiscal consolidations periods relatively to the non-fiscal consolidation periods. The difference is more important (0.88% points

improvement in consolidation time vs 0.39 % points in normal time) 3 years after the shock.

Figure 3.2 – Comparison of average public efficiency between fiscal consolidations and normal times



3.5 Methodology

Our estimation strategy relies on the combination of local projections method and augmented inverse propensity score following Jordà and Taylor (2016) and Banerjee and Zampolli (2019). This identification methodology is a novel and powerful approach in the macroeconomic context to deal with random allocation bias and other sources of endogeneity.

To proper identify the causal impact of fiscal consolidation, we need to evaluate the efficiency of those that experienced with fiscal adjustments and those that did not.

In the randomization assignment, an estimate of the average treatment effect would be the better way to reach our objective. Although we took caution that our fiscal consolidation

episodes reflect some exogenous shocks of fiscal policy, the decision to adjust or not may be strongly related to some fiscal variables such as the level of the debt or deficit.[14] This includes some underlying differences between countries that adjust and not relatively to the observable variables, leading to a selection or allocation bias. In such context, the identified causal effects may include other aspects beyond the fiscal consolidation impact.

To deal with these issues, our strategy requires three steps. First, we estimate the policy propensity score for each observation regarding the consolidation decision. This score reflects the likelihood that a fiscal consolidation episode arises based on their determinants. We estimate a saturated probit model designed as follows:

$$\hat{p_{i,t}} = Pr(D = 1|X_{it}) = \Phi(X, \Gamma) \tag{3.11}$$

Where $\hat{p_{it}}$ is the probability of experiencing a fiscal consolidation and X_{it} is a vector of policy factors. While Γ represents the set of estimated coefficients, Λ is the probit distribution function. The second step consists to re-randomize our sample and to fit the outcome model. We use the inverse of the propensity score to re-balance the sample. Indeed, countries engaged in fiscal consolidations episodes, in our sample, includes too many observations with high propensity scores compared to a sample obtained by a standard randomization process.[15] Using the inverse of propensity score to weigh observations, we mimic the quasi randomization assignment i.e. higher weight is attributed to observations with small propensity score (those underrepresented amongst the treated) in the treatment group and inversely in the control group. Propensity score is acknowledged as an useful tool to eliminate all systematic differences between outcomes due to observables since the seminal work of Rosenbaum and Rubin (1983).

With a more balancing sample, we use the following Local Projection method of Jordà (2005) to derive the potential outcomes:

[14] Jordà and Taylor (2016) provide evidence of the predictability of CAPB based fiscal consolidations episodes even after using narrative based fiscal episodes as instrumental variable.

[15] Reversely, our control group contains very small number of observations with high propensity score than if we have a randomized sample.

$$\Delta eff_{i,t+h} = \alpha_i^h + \Lambda^h D_{i,t} + \theta_0^h \Delta eff_{i,t-1} + \theta_1^h \Delta eff_{i,t-2} + \gamma_0^h TREND + \epsilon_{i,t+h} \tag{3.12}$$

with $h \in [0, 5]$. $\Delta eff_{i,t+h} = (eff_{i,t+h} - eff_{i,t-1})/eff_{i,t-1} \times 100$ represents the cumulative change of efficiency score, in percentage, between the period t-1 and t+h. $D_{i,t}$ is our policy dummy variable that takes 1 in the presence of fiscal consolidations and 0 otherwise. $\Delta eff_{i,t-1}$ and $\Delta eff_{i,t-2}$ outline the change of efficiency score for t-1 and t-2. We introduce $TREND$ to account for the time improvement of efficiency. While α_i denotes the country fixed effects, $\epsilon_{i,t+h}$ is the idiosyncratic term.

The use of local projections has several merits. First, it allows the estimation of direct and indirect effects of fiscal consolidations on efficiency. Second, this strategy is more robust to misspecification than other autoregressive strategies because it estimates direct impulse response from individual regression at each h horizon. Third, it is a very flexible estimation method with highly non linear and state dependent specification to account for realism in the econometric analysis. Moreover, local projection is widespread used in the fiscal multipliers, financial crises and fiscal consolidations literature, see e.g. (Auerbach and Gorodnichenko (2012); Banerjee and Zampolli (2019); Diniz (2018); Jordà (2005); Jordà and Taylor (2016); Pontines (2018)).

Finally, the third step consists to compute a specific average treatment effect using the AIPW estimator developed by Lunceford and Davidian (2004).

$$\begin{aligned}\hat{\Lambda}^h_{AIPW} = \frac{1}{n} \sum_i \sum_t \Bigg\{ & \left[\frac{D_{i,t}(eff_{i,t+h} - eff_{i,t-1})}{\hat{p_{i,t}}} - \frac{(1 - D_{i,t})(eff_{i,t+h} - eff_{i,t-1})}{1 - \hat{p_{i,t}}} \right] \\ & - \frac{D_{i,t} - \hat{p_{i,t}}}{\hat{p_{i,t}}(1 - \hat{p_{i,t}})} \left[(1 - \hat{p_{i,t}}) m_1^h(X_{it}, \hat{\eta}_1^h) + \hat{p_{i,t}} m_0^h(X_{it}, \hat{\eta}_0^h) \right] \Bigg\}\end{aligned} \tag{3.13}$$

where $m_j^h(.,.)$ defines the conditional mean of $eff_{i,t+h} - eff_{i,t-1}$ for the treatment group ($j = 1$) and the control group ($j = 0$) and $\hat{\eta}_j^h$ refers to the specific parameters.

This estimator fits into the double robust class of estimators and it is the most efficient i.e. with the smallest asymptotic variance. This estimator brings together the power of Regression Adjustment and Inverse Propensity score Weighting method with a stabilization term. According to Glynn and Quinn (2009), the stabilization term is expected to be null if we use the correct specification of the entire data generating distribution, while different to zero whether the policy propensity score is close to zero or one. [16]

In addition, the AIPW estimator achieves better results than comparable estimators when the treatment or outcome model is misspecified and presents relatively equal or lower mean square error whether both models are well specified. Moreover, the AIPW provides unbiased estimates as long as at least one of the treatment or the outcome model is correctly specified (Lunceford and Davidian, 2004; Wooldridge, 2007).

3.6 Results

We summarize in this section our estimates coming from the previous specifications. As mentioned above, our estimation procedure includes several stages. We first begin with the first-stage (eq 3.11) results of predicting the policy propensity score model in Table 1, based on saturated probit specifications. The findings confirm that fiscal consolidations are not randomly assigned but are endogenous to several factors. From the most parsimonious equation with lag of the dependent variable, we increasingly add the output gap , government revenue, public spending, growth rate of GDP and debt to GDP ratio. Based on the column (6), fiscal consolidation appears to be a long lasting process (reflected by the significant and positive impact of the lag dependent variable), likely occurs during huge fiscal imbalances (large public spending and low government revenue) as well as when the economy is growing below potential. Moreover, the AUC [17] statistic of 0.90 (column (6))confirms the power of our predictive model. This means that our model offers better prediction of fiscal adjustment decisions than a random predictor that give the same probability (0.5) to a country in each

[16] It is not necessary to truncate the propensity score weights with this estimator (Imbens, 2004).

[17] AUC means Area Under the Curve. It provides the level of false positive and true positive for each probability. It is commonly used to estimate the classification property. See Jordà and Taylor (2016).

of the two groups. In addition, table (3.3) and figure (3.12) provide strong evidence of good balance diagnostics. Indeed, table (3.3) shows that the use of propensity score to weigh observations has considerably clear a great part of the difference of covariates between treated and control group. Further, figure (3.12) confirms a good overlap between treatment and control observations. Addressing allocation bias issue, we can now estimate the average treatment effect.

3.6.1 Average Treatment effects of fiscal consolidations

After mimic a quasi-randomization assignment through the Inverse propensity weightings, we estimate the second stage outcome model (eq3.12) using the Local Projection (LP). The average treatment effect of fiscal consolidations is computed following the AIPW estimator (equation3.13).

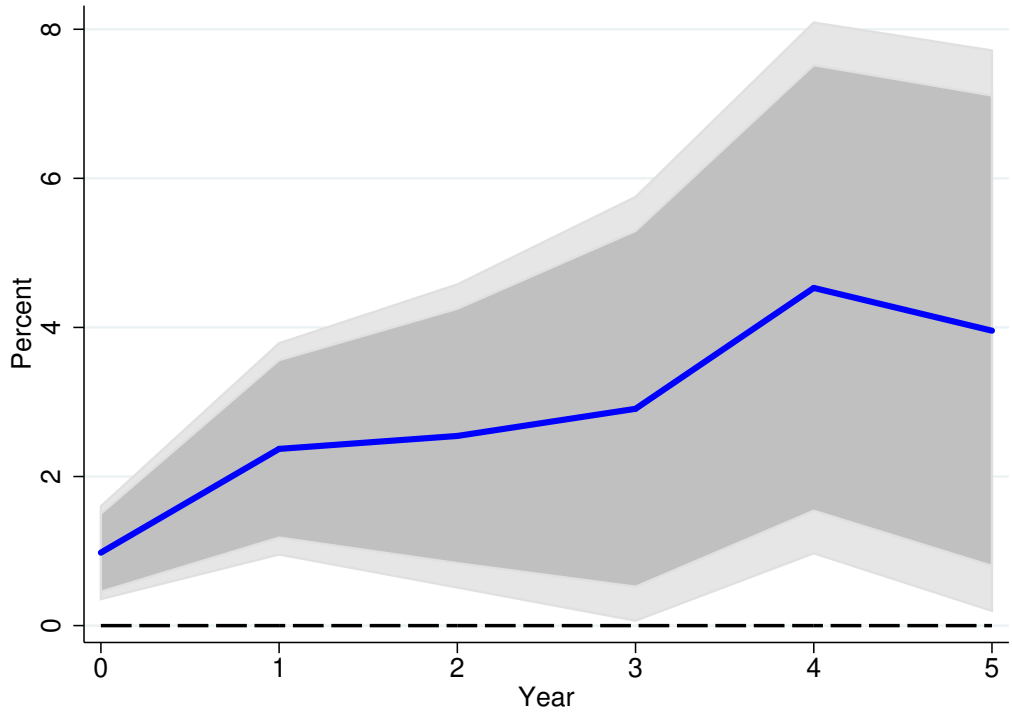
figure(3.3) depicts graphically the cumulative response of public investment efficiency to fiscal consolidation over our 5 year forecast horizon.

While the dark gray and light gray areas are respectively 90% and 95% confidence intervals, the solid blue line illustrates the point estimates.

Based on coefficients in table(3.4), public investment efficiency positively and significantly reacts to fiscal contractions episodes over time, with higher cumulative impact of around 4 percentage points up to 5 years after the onset of shock. Put differently, implement a fiscal consolidation program leads to short run efficiency gains relative to not engage in the adjustment process.

Mostly relying on spending cuts than tax hikes (Heylen et al., 2013; Schaltegger and Feld, 2009; Von Hagen et al., 2002), consolidations significantly decrease public spending relative to government consumption (Bamba et al., 2019; De Haan et al., 1996; Roubini and Sachs, 1989). With small room for investment and the need to support long run growth and sustainable development, governments take a close look at of fiscal policy management and meticulously select high potential productive sectors to investment.

Figure 3.3 – Cumulative response of efficiency to fiscal consolidation over 6 years



3.6.2 Alternative definitions of fiscal consolidations

Our baseline results rely on the Alesina and Ardagna (2013) of fiscal adjustments episodes. We use a range of alternative definitions to check whether results are sensitive to the way we identify fiscal consolidations instances.

First, we increase the initial threshold of CAPB to reinforce the discretionary aspect of the policy. Under "Threshold 1", a fiscal consolidation corresponds to either 2 years of subsequent improve in the CAPB with cumulative change of at least 2.5 percentage points (pp) of GDP or 3 years with at least 3.5 percentage points. This hint at countries have an uniform reactions to discretionary shocks in fiscal policy. "Threshold 2" ("Threshold 3") use 2 years & 3 pp (4 pp) or 3 years & 4 pp (5 pp) as criterion.

Second, we account for the country-specific heterogeneity in fiscal responses to shock by using the novel approach of Wiese et al (2018) based on the bai perron structural filter. This approach relies on the identification of structural break in the Data Generating Process (DGP) of CAPB to define fiscal consolidation episodes.[18]

Third, we extend the CAPB computation framework following Fatas and Mihov (2003) approach. Indeed, Alesina and Perotti (1995) use only unemployment and trend as covariates to adjust fiscal variables. Instead, Fatas and Mihov (2003) regress primary deficit on GDP, interest rate and inflation . While GDP captures a more comprehensible aspect of the state of economy (especially in emerging countries), interest rates and inflation may affect the budget, through decision to invest in public infrastructure, delay in tax collection or indexation of some spending components.

Fourth, we use the CAPB database computed by Kose et al. (2017). Authors use output gap elasticity of expenditures and revenues to extract the discretionary part of the fiscal policy. As shown by Figure(3.4), the positive and significant efficiency gains during fiscal consolidations episodes is robust to various definitions of fiscal adjustments.

[18]for further detail see Wiese et al. (2018) and Wiese (2014).

Figure 3.4 – Cumulative response of efficiency to fiscal consolidation using alternative definitions

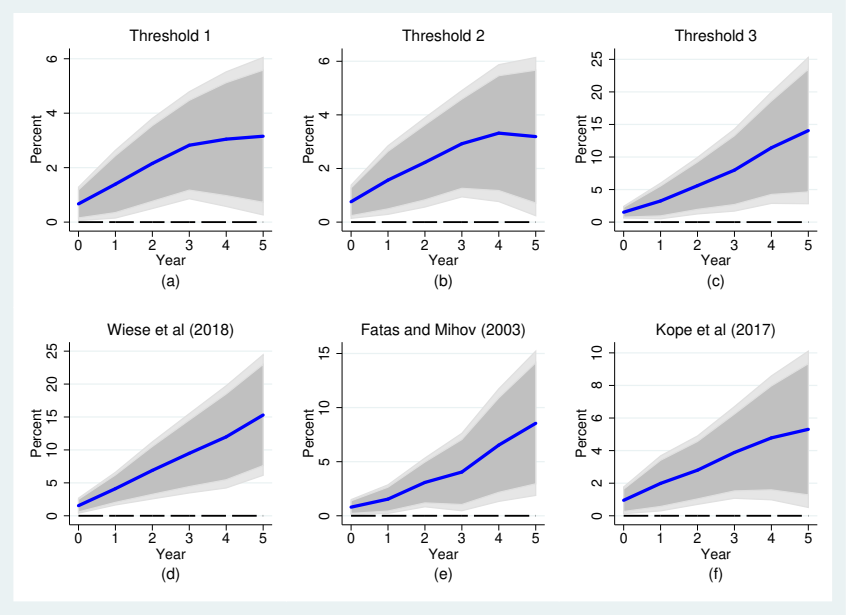
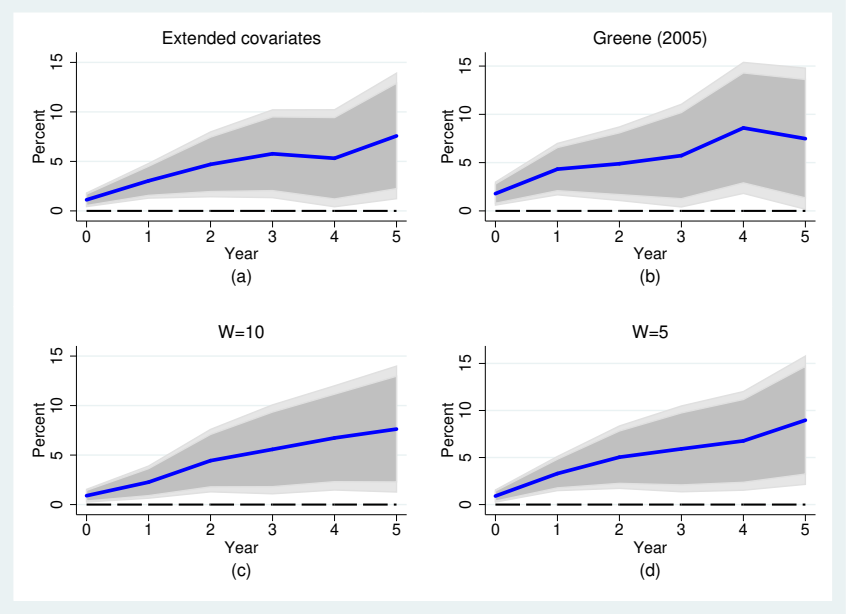


Figure 3.5 – Cumulative response of efficiency to fiscal consolidation: additional controls, efficiency alternative and other propensity score assumptions



3.6.3 Extended treatment and outcome model

We now extend our treatment and outcome model using additional control variables. Indeed, our causal interpretation of the efficiency-fiscal consolidation nexus mainly relies on the "selection on observables" assumption. This means that we have selected sufficient and plausible determinants of fiscal consolidation decisions in order to accurately predict the probability and use them to re-randomize the assignment. As recommended by Lunceford and Davidian (2004) and following Diniz (2018); Jordà and Taylor (2016); Kuvshinov and Zimmermann (2019), we double check whether this assumption holds by including in the equation(3.11) additional potential factors of fiscal consolidations namely: (i) the real interest rate; (ii) the balance current account; (iii) the total investment; (iv) the national savings; (v) the trade openness; and (vi) the foreign direct investment, apart from real interest rate, all variables are in percentage of GDP.

Moreover, we include additional covariates in the outcome model to account for the institutional aspect. It is well known that public finance management is closely related to sound and strong institutions. We refer to the quality of governance (gov_icrg) and the investment profile ($invp_icrg$) as relevant for investment efficiency. Figure 3.5 panel (a) reveals that our results remains qualitatively the same.

3.6.4 Alternative efficiency estimators: True Fixed Effects (TFE) Greene 2005

We now change our efficiency estimators in order to account for the flexibility of specification. Our benchmark specification, using Kumbhakar et al. (2015) process, rely on the two stage procedure and separate the error term in four component. Greene (2005) is a one step specification model which disentangle specific units characteristics from inefficiency. Figure (3.5) panel (b) confirms the qualitative robustness of our baseline results.

3.6.5 Alternative assumptions

The baseline specification use the full distribution of propensity score to mimic the sample randomization assignment. This distribution can include some outliers observations with weights near zero or above 10. To mitigate the influence of potential outliers, Imbens (2004) and Cole and Hernán (2008) suggest to truncate the maximum weights to 10. Figure 3.5 displays results after our truncation maximum weights process to 10 (panel (c)) and 5 (panel (d)). The significant and positive impacts of fiscal consolidations on public investment efficiency still at work.

3.7 Sensitivity

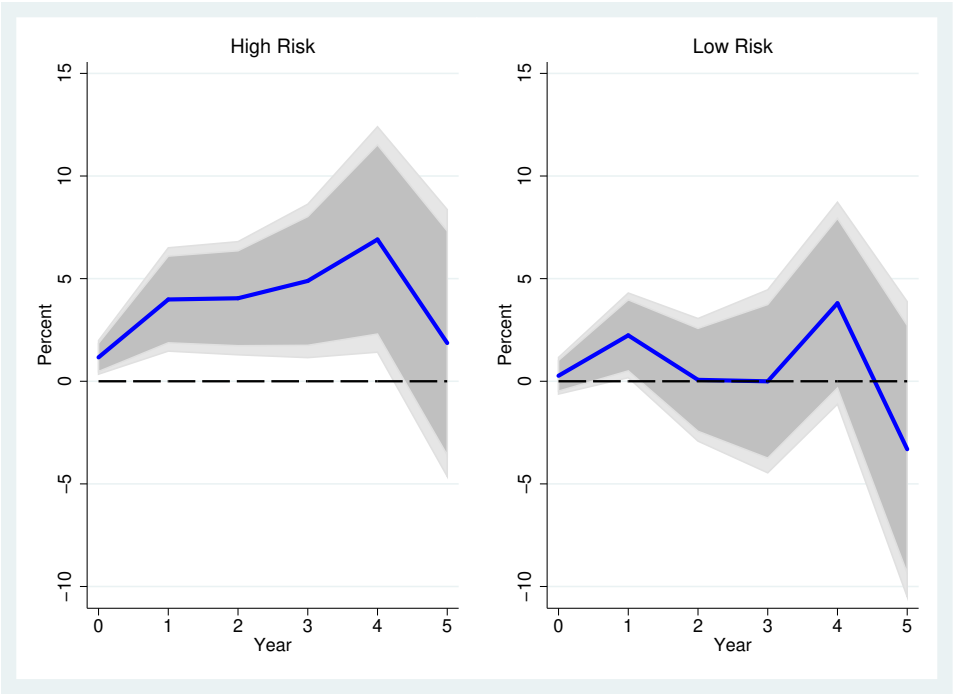
3.7.1 Perception of the default risk

We now investigate the sensitivity of fiscal consolidations impact to others fiscal conditions, especially the perception of default risk. Indeed, the expansionary effect and successful of fiscal consolidations are strongly related to the market perception regarding the sustainability of deficit and debt (Guajardo et al., 2014). As such, higher market pessimism should lead to sharp and credible fiscal consolidations in order to convince the creditors and reduce risk premium. As explained above, efficiency gains seems to be a credible channel of fiscal consolidations to positively impact output growth. Hence, we expect that in some "bad" fiscal conditions, proxy by a pessimism of creditors, fiscal consolidations could lead to a significant improvement of public investment efficiency relatively to "good" fiscal conditions. Drawing upon the Institutional Investor Rating (IIR)[19] index, we split our sample into a high perception of the sovereign default risk (index value below the median of the distribution) and the low perception of sovereign risk (index value above the median of the distribution).

Figure (3.6) presents significant and positive efficiency gains for countries that experi-

[19]The Institutional Investor Ratings (IIR) index relies on assessments of sovereign risk by private sector analysts which range from 0 to 100 (with 0 assigned to the higher perceived sovereign default probability).

Figure 3.6 – Cumulative impact of fiscal consolidation on public investment efficiency: High vs Low perceived sovereign risk



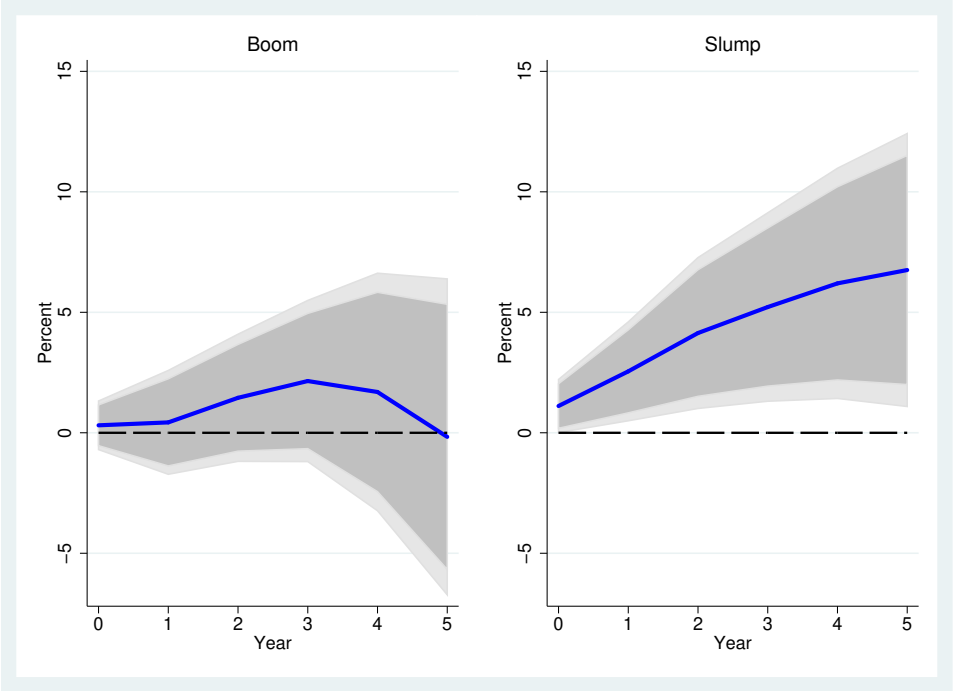
encing fiscal consolidations with high sovereign default risk, up to four years after the onset of the program. When there is a small perception of the sovereign default risk, fiscal consolidations do not significantly impact the evolution of technical public investment efficiency. To wrap up, the presence of tight fiscal conditions lead governments to engage drastic fiscal consolidations in order to improve their credibility on financial markets.

3.7.2 Business cycle

We account now for the state dependency of business cycle. Using the Hodrick and Prescott filter, we characterize the economy in a boom or slump cycle. While the boom period usually depicts an expansion period where the economy is above its potential output, slump denotes a recession phase in which activity is at its lower level. Figure (3.7) reveals that countries that experienced fiscal consolidations in this latter period get significant gain in efficiency with respect to other countries in recession. However, fiscal consolidations do not lead to

significant improvement in efficiency during expansion periods. The scarcity of resource in low output growth period constrains governments to boost activity through better allocation in the high productivity investment and as such increase efficiency of their public investment. This result is quiet interesting because it unveils the benefit of counter-cyclical fiscal policy on public finance management.

Figure 3.7 – Cumulative impact of fiscal consolidation on public investment efficiency: Boom vs Slump

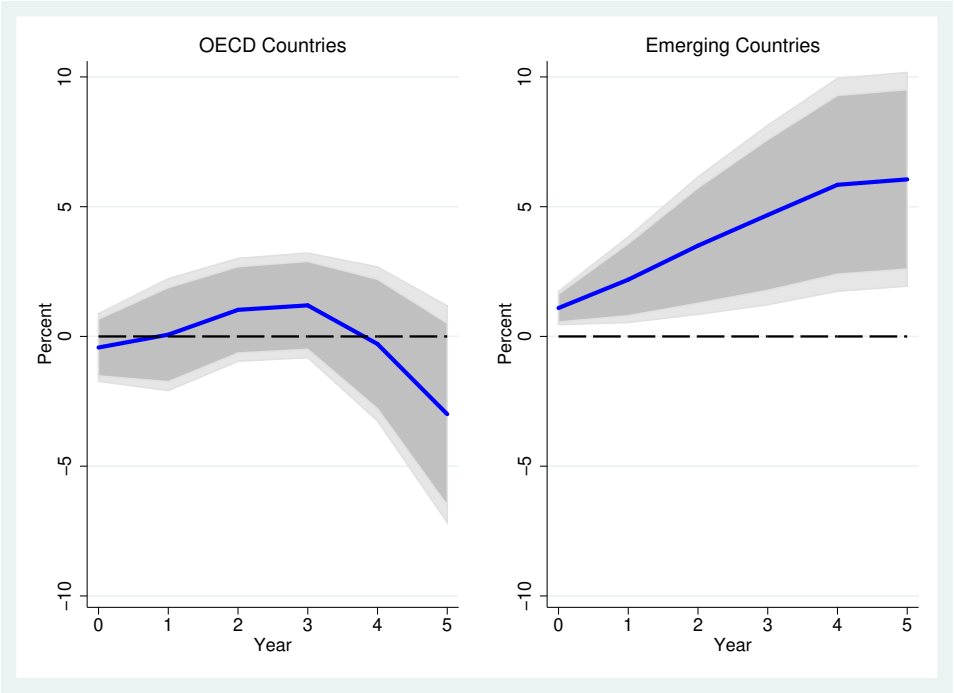


3.7.3 Development stage

We are interesting now on the role of structural difference between countries capturing by the level of development. Indeed, there likely exists some underlying difference in the public finance management between developed and emerging or developing countries due to the presence of strong institutions to surround the use of public finance. Such differences may at work to fiscal consolidations and lead to heterogeneous impacts. Figure (3.8) supports our intuition: Amongst emerging countries, fiscal consolidations significantly raises the public

investment management over the entire period with the cumulative impact at the end of 6.05 percentage points. Regarding OECD countries, fiscal consolidations do not appear to make any difference in terms of quality of management.

Figure 3.8 – Cumulative impact of fiscal consolidation on public investment efficiency: OECD vs Emerging Countries



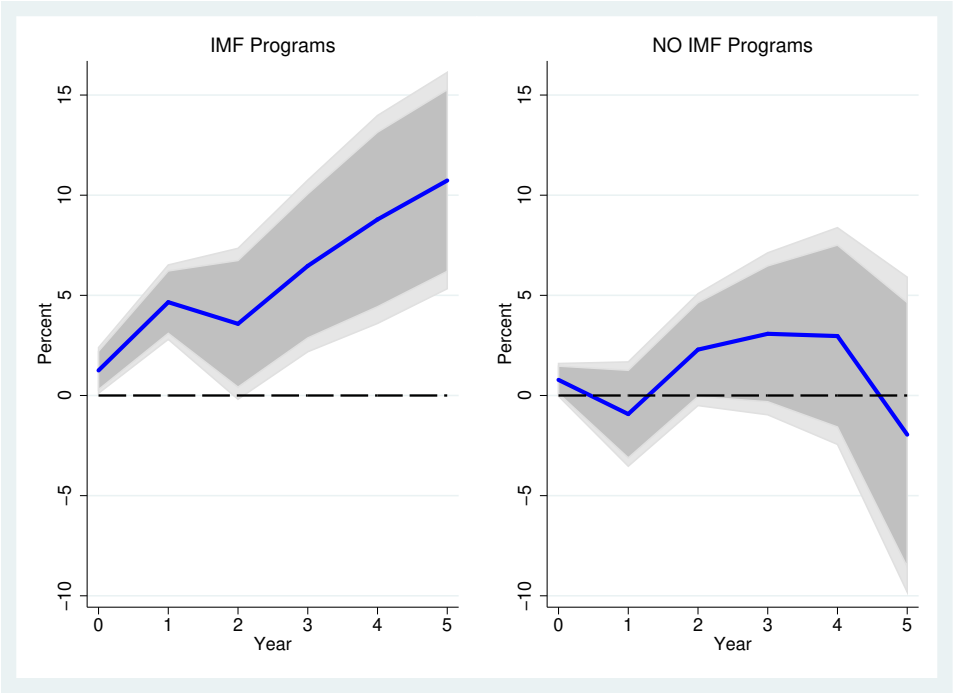
3.7.4 IMF programs

Bringing together almost all countries in the world , one of the main activities of the IMF is to provide technical and financial supports to its member states. Governments usually call for IMF intervention when they face financial distress and unsustainable budget deficit. IMF programs are then design to get countries out of such bad situations with sometimes important fiscal actions.[20] As such, we investigate the sensitivity of our baseline results to the support of IMF during fiscal contractions. Figure (3.9) clearly demonstrates the significant improvement of efficiency due to fiscal consolidations under IMF programs. Structural

[20] According to the (IEO, 2003) annual report, the average target of fiscal retrenchment was 1.7% of GDP over the 1993-2001 period within 133 IMF programs.

conditionality associated with technical assistant appears to be useful for public finance management.

Figure 3.9 – Cumulative impact of fiscal consolidation on public investment efficiency: IMF vs No IMF Programs



3.7.5 Monetary Policy: Real Effective Exchange and Short term policy interest rate

To improve the likelihood of successful or their expansionary effects, fiscal consolidations are sometimes surrounded by accompanying policies. Indeed, IMF (2019) highlights that growth-friendly or less costly fiscal consolidations require accommodative monetary policy through lower interest rate and depreciation of real exchange rates. While decrease in interest rates soften the shock on global investment and consumption, the real exchange rate depreciation will foster output growth through increase in net exports. We investigate how these two policies impact our baseline findings. Although Figure (3.10) denotes efficiency gains of fiscal consolidations associated with real depreciation policy, Figure (3.11) shows no significant

increase in public investment efficiency due to fiscal consolidations with low interest rate. The depreciation of the real effective exchange rate both offset the decrease of global demand from governments by increasing the net exportations. This gain in competitiveness puts pressure on domestic economy, on government as well, and increases the relationship with foreign markets including skills and technology exchange. To support the overall development and more precisely that of private sector, governments should enhance infrastructure and energy through gain in efficiency and performance.

Figure 3.10 – Cumulative impact of fiscal consolidation on public investment efficiency: Appreciation vs Depreciation REER

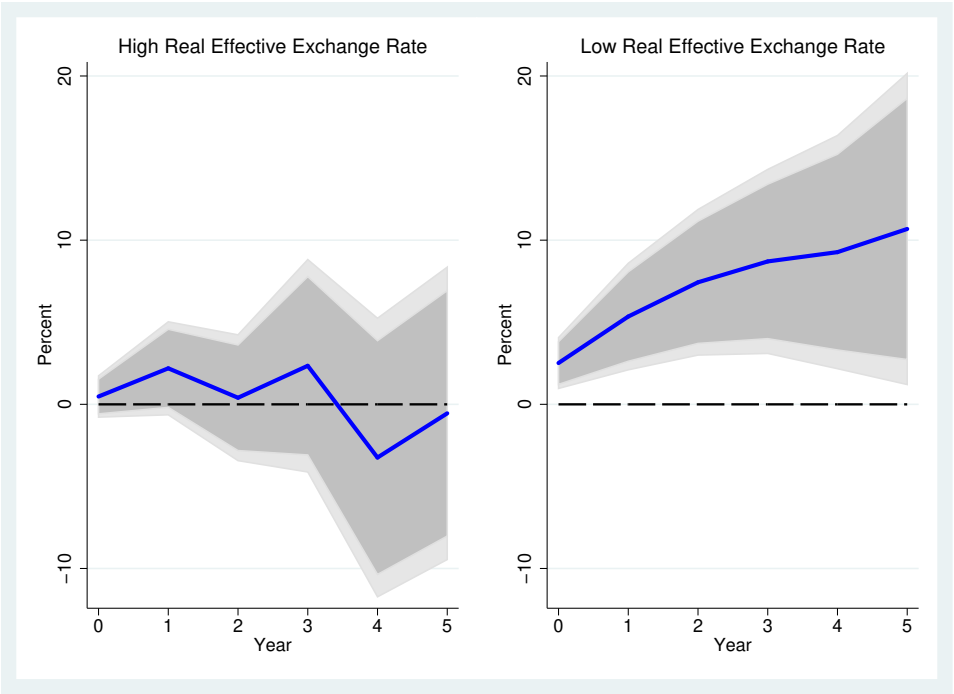
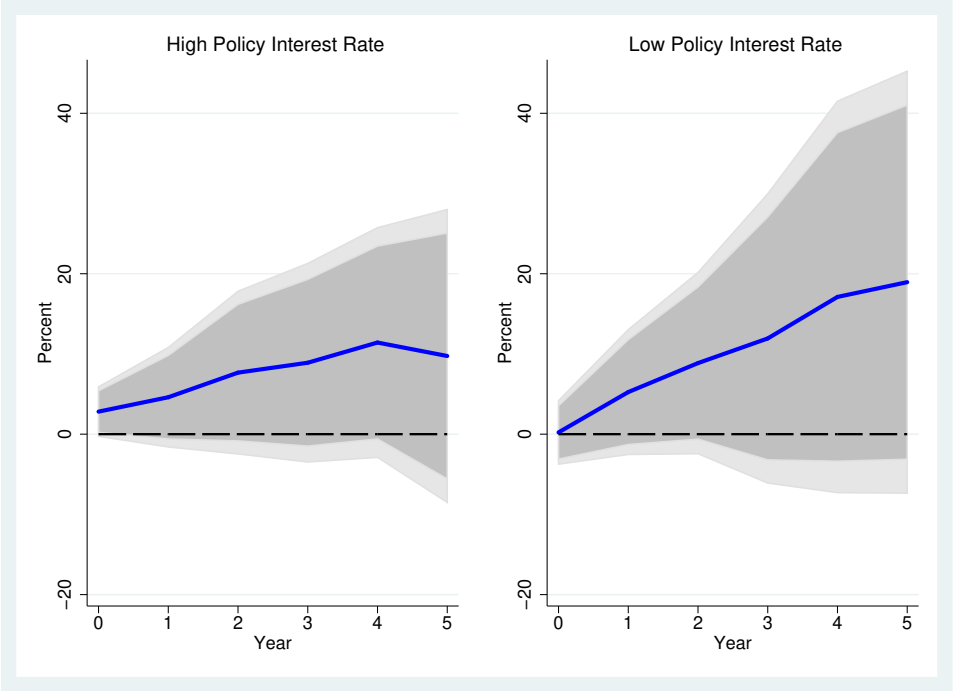


Figure 3.11 – Cumulative impact of fiscal consolidation on public investment efficiency: High vs Low Policy Interest Rate



3.8 Conclusion

We investigate in this paper the impact of fiscal consolidations on the transient technical public investment efficiency. Drawing upon a "treatment effects" local projection (Jordà and Taylor, 2016) methodology, we provide evidence of short run significant efficiency gains during fiscal consolidations periods on a sample of 53 developed and emerging countries over 1980-2011 period.

The positive gain goes up to 5 years after the onset of fiscal programs with a cumulative improvement of about 4% percentage points at the end foresight horizon. Robust to a wide range of alternative specifications, our baseline findings appear to be sensitive to the perceived sovereign default risk, economy slack, development stage, the presence of IMF programs as well as the policy mix.

Indeed, technical public investment efficiency gain is higher mostly in the emerging countries, when the economy is in slump as well as well when the perception of the sovereign risk is high. Moreover, fiscal consolidations accompanied by real depreciation highly improve the management of public capital. These findings highlight the fact that fiscal consolidations may ensure sustainable long run economy growth path if they improve the quality of government management, especially in the public investment sector.

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3.9 Appendix

Unobserved Component Model (UCM)

The Unobserved Component Model is a well known approach used in economics, especially in the signal extraction problem. This method consists to extract the common unobserved part of the signal from an each individual source of information.

The first application of this tool, as statistical aggregate method, stems from (Kaufmann et al., 1999, 2011) with the computation of the World Governance Indicators (WGI) of the World Bank. As explained in Kaufmann et al. (2011), each individual source of data measures imperfectly the notion of governance but contains a part of the message. In order words, we have a signal extraction problem and need to find how extract the informative signal relative to the underlying component of governance common to each of the data source and how to be close as much as possible to the real measure of governance in a country using various data source. Kaufmann et al. (2011) combine hundreds of individual underlying variables from dozens of different data sources to get six aggregate governance indicators. Regarding the infrastructure index, we face a similar problem since "infrastructure" covers a very wide range of dimensions including telecommunications, transport, energy, etc. coming from different sources with various measurement approaches.

Calderón and Servén (2004) use the UCM approach, with two other aggregate methods, to assess the impact of infrastructure on income inequality. They combine four dimensions of infrastructure, such as Telecommunications, Energy, Roads, and Railways, both covering quality and quantity of aspect of infrastructure.

Donaubauer et al. (2016b) compute a composite index of infrastructure with UCM approach by taking into account other dimension such financial infrastructure.

Table 3.1 – Episodes of fiscal consolidations

Countries	Adjustment periods	number
Argentina	1984-1985; 1991-1993; 2002-2004	3
Australia	1983-1988; 1993-1997	2
Austria	1996-1997; 2000-2001	2
Belgium	1984-1987; 1993-1995	2
Bolivia	2003-2006	1
Brazil	1999-2000	1
Bulgaria	2000-2001; 2010-2011	2
Canada	1981-1982; 1990-1997	2
Chile	1987-1989; 1994-1995; 2003-2006; 2010-2011	4
China	2004-2007	1
Colombia	1985-1987; 2000-2001; 2003-2004	3
Costa Rica	1981-1982; 1991-1992; 1995-1997	3
Denmark	1983-1986; 2003-2005	2
Dominican Republic	2004-2007	1
Finland	1984-1985; 1988-1989; 1993-1994; 1996-1998	4
France	1994-1999 ; 2010-2011	2
Germany	1982-1985; 1996-2000; 2004-2007	3
Greece	1986-1987; 1990-1991; 2005-2006	3
Honduras	1985-1989, 1995-1996; 2003-2004	3
Hong kong	2006-2007; 2009-2010	2
Hungary	1999-2000; 2003-2004; 2007-2008	3
Iceland	1990-1992; 2004-2006	2
Indonesia	1989-1990	1
Iran	2003-2004	1
Ireland	1986-1989	1
Israel	1993-1995; 1997-2000; 2004-2007	3
Italy	1982-1983; 1988-1992; 1995-1997; 2006-2007	4
Japan	1981-1987	1
Mexico	1983-1984; 1986-1989	2
Netherlands	1981-1985; 2004-2006	2
New Zealand	1985-1988; 1992-1995; 2000-2005	3
Nicaragua	1991-1992; 1997-1998; 2010-2011	3
Norway	1981-1985; 1988-1990; 1993-1996; 1999-2000; 2004-2006	5
Pakistan	1988-1990 ;1993-1994; 1998-1999; 2006-2007	4
Panama	1985-1986; 1989-1990; 2005-2007	3
Paraguay	1985-1986; 1989-1990; 1993-1994; 2003-2004	4
Peru	1984-1985; 1988-1989; 2004-2007; 2010-2011	4
Portugal	1981-1984; 2002-2003; 2006-2007; 2010-2011	4
Romania	1997-1998; 2010-2011	2
Russia	2003-2005; 2010-2011	2
South Africa	1994-1995; 1998-1999; 2004-2007	3
South Korea	1995-2000	1
Spain	1983-1988; 2010-2011	2
Sweden	1981-1987; 1993-1998; 2004-2005	3
Switzerland	1992-1996; 2005-2006	2
Turkey	1981-1983; 1994-1995; 1998-1999; 2002-2005	4
United Kingdom	1981-1986 ; 1995-2000; 2010-2011	3
United States	1981-1982	1
Uruguay	1985-1986; 1990-1991; 2000-2005	3
Venezuela	2002-2005	1
	Total	123

Table 3.2 – Fiscal Treatment Regression, satured Probit Estimators (average marginal effects)

Probit model of treatment at time t (fiscal consolidation event)						
	(1)	(2)	(3)	(4)	(5)	(6)
$CONS_{it-1}$	0.383***	0.365***	0.367***	0.397***	0.397***	0.397***
	(0.012)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)
GDP_HPit-1		-1.711***	-1.705***	-0.813***	-0.806**	-0.776**
		(0.326)	(0.323)	(0.300)	(0.325)	(0.336)
REV_{it-1}			-0.009***	-0.039***	-0.039***	-0.039***
			(0.002)	(0.003)	(0.003)	(0.004)
EXP_{it-1}				0.037***	0.036***	0.036***
				(0.003)	(0.003)	(0.003)
$GROWTH_{it-1}$					-0.000	-0.000
					(0.003)	(0.003)
$DEBT_{it-1}$						0.000
						(0.000)
Observations	1258	1258	1258	1258	1258	1258
Model AUC	0.839	0.851	0.856	0.899	0.899	0.902
s.e.	0.0126	0.0124	0.0119	0.00924	0.00924	0.00912

Standard errors in parentheses and clustered by country. $CONS_{it-1}$ refers to the treatment (fiscal consolidations), GDP_HPit-1 is the cyclical component of logarithm of the output. REV_{it-1} and EXP_{it-1} represents respectively the revenues and primary expenditure of government. While $GROWTH_{it-1}$ designs the rate of the output growth, $DEBT_{it-1}$ denotes the level of debt. All variables are included in the lagged value

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

Table 3.3 – Covariates balance checks between treatment and control groups

	Before Matching				After Matching			
Variables	**Treated**	**Control**	**Standardized Bias (%)**	**Variance Ratio**	**Treated**	**Control**	**Standardized Bias (%)**	**Variance Ratio**
Const-1	.70442	.1174	148.5	1.48	.62687	.62687	0.0	1.00
lgdp_hp	-.00938	.00319	-38.7	1.39	-.01355	-.00905	-13.9	1.32
lgdp_growth	2.7019	3.3765	-19.1	1.40	3.8696	3.8904	0.6	2.06
lexpd_gdp	32.863	30.114	21.1	1.14	29.807	32.321	-19.3	1.08
lreven_gdp	33.117	31.692	10.7	1.10	30.991	33.473	-18.6	1.13
ld	56.664	54.684	6.3	0.89	50.448	50.518	0.2	1.85
lrintr	6.568	6.6634	0.8	1.24	9.2974	9.1661	1.0	2.15
lBCA_NGDPD	-.88178	-1.0006	2.2	1.02	.08403	.73354	-11.9	0.65
lNID_NGDP	22.468	23.802	-24.3	1.35	21.538	21.167	6.8	1.81
lNGSD_NGDP	21.21	22.157	-13.7	1.15	21.301	21.802	-7.2	1.10
ltrade_gdp	59.281	64.251	-16.8	0.59	64.57	58.667	19.9	0.91
lfdi_gdp	-.52942	-.907	12.8	0.60	-1.2098	-.83503	-12.7	0.69

Following Rubin (2001), a standardized bias below 25% suggest there is a not significant difference between treated and control group for this specific variable. Besides, Rubin (2001) use the ratio of between treated and control group variances as an indicator of balance property. A good balance ratio should be close to 1.0 and a bad balance ratio is less than 0.5 or higher than 2.0

Table 3.4 – AIPW baseline

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ATE_IPWRA	0.98***	2.37***	2.54**	2.91*	4.53**	3.96**
	(0.32)	(0.72)	(1.04)	(1.45)	(1.82)	(1.92)
Observations	282	282	282	282	282	282

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.5 – AIPW robustness: treatment model extend

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ATE_IPWRA	1.12***	3.04***	4.70***	5.77**	5.32**	7.57**
	(0.35)	(0.89)	(1.67)	(2.26)	(2.50)	(3.23)
Observations	223	223	223	223	223	223

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.6 – AIPW robustness: Greene Estimator

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ATE_IPWRA	1.79***	4.33***	4.88**	5.73**	8.60**	7.48*
	(0.61)	(1.36)	(1.94)	(2.71)	(3.46)	(3.73)
Observations	282	282	282	282	282	282

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.7 – ATE Risk premium profile

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ATE u wts high_risk	1.16***	3.98***	4.04***	4.89**	6.91**	1.86
	(0.42)	(1.28)	(1.41)	(1.91)	(2.80)	(3.32)
ATE u wts low_risk	0.27	2.24**	0.07	-0.00	3.80	-3.31
	(0.46)	(1.05)	(1.52)	(2.27)	(2.51)	(3.67)
Pvalue_eq	0.15	0.30	0.06	0.11	0.43	0.32
Observations	282	282	282	282	282	282

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.8 – ATE: Business Cycle

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ATE u wts boom	0.31	0.43	1.45	2.15	1.69	-0.17
	(0.51)	(1.10)	(1.35)	(1.71)	(2.52)	(3.34)
ATE u wts slump	1.11*	2.55**	4.14**	5.22**	6.20**	6.75**
	(0.56)	(1.05)	(1.60)	(2.00)	(2.44)	(2.89)
Pvalue_eq	0.34	0.20	0.23	0.27	0.25	0.20
Observations	282	282	282	282	282	282

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.9 – ATE: Development Stage

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ATE_IPWRA_dev	-0.43	0.07	1.03	1.20	-0.29	-3.00
	(0.66)	(1.10)	(1.01)	(1.03)	(1.51)	(2.13)
ATE_IPWRA_ndev	1.10***	2.19**	3.50**	4.68**	5.84***	6.05***
	(0.33)	(0.84)	(1.35)	(1.76)	(2.09)	(2.10)
Pvalue_eq	0.05	0.14	0.15	0.10	0.02	0.00
Observations	282	282	282	282	282	282

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.10 – ATE: IMF program

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ATE u wts imfp	1.25**	4.66***	3.58*	6.47***	8.79***	10.73***
	(0.58)	(0.95)	(1.92)	(2.19)	(2.65)	(2.76)
ATE u wts nimfp	0.78*	-0.93	2.29	3.08	2.97	-1.95
	(0.42)	(1.33)	(1.43)	(2.06)	(2.76)	(4.01)
Pvalue_eq	0.51	0.00	0.57	0.25	0.11	0.01
Observations	282	282	282	282	282	282

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.11 – ATE: REER

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ATE u wts High REER	0.48	2.19	0.40	2.35	-3.24	-0.55
	(0.64)	(1.45)	(1.96)	(3.30)	(4.33)	(4.54)
ATE u wts Low REER	2.52***	5.35***	7.43***	8.70***	9.27**	10.68**
	(0.79)	(1.66)	(2.26)	(2.86)	(3.62)	(4.84)
Pvalue_eq	0.05	0.16	0.03	0.19	0.04	0.13
Observations	228	228	228	228	228	228

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

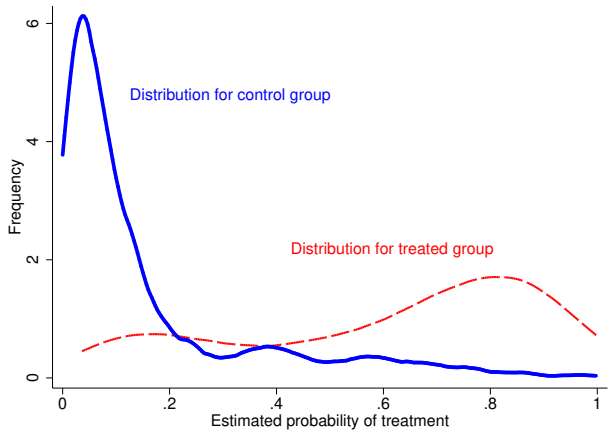
Table 3.12 – ATE Policy Interest Rate

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
ATE u wts High Policy Interest Rate	2.81	4.60	7.67	8.91	11.42	9.75
	(1.57)	(3.16)	(5.17)	(6.32)	(7.31)	(9.32)
ATE u wts Low Policy Interest Rate	0.22	5.25	8.86	11.93	17.11	18.95
	(2.02)	(3.97)	(5.76)	(9.20)	(12.45)	(13.42)
Pvalue_eq	0.23	0.88	0.85	0.76	0.67	0.45
Observations	61	61	61	61	61	61

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 3.12 – Distribution of propensity score for treatment and control groups



Notes: The policy propensity score is computed the probit specification which includes country fixed effects (satured probit). The long dashed red line represents the predicted probabilities of experiencing fiscal consolidations for treatment group while the solid blue line displays those probabilities for control group.

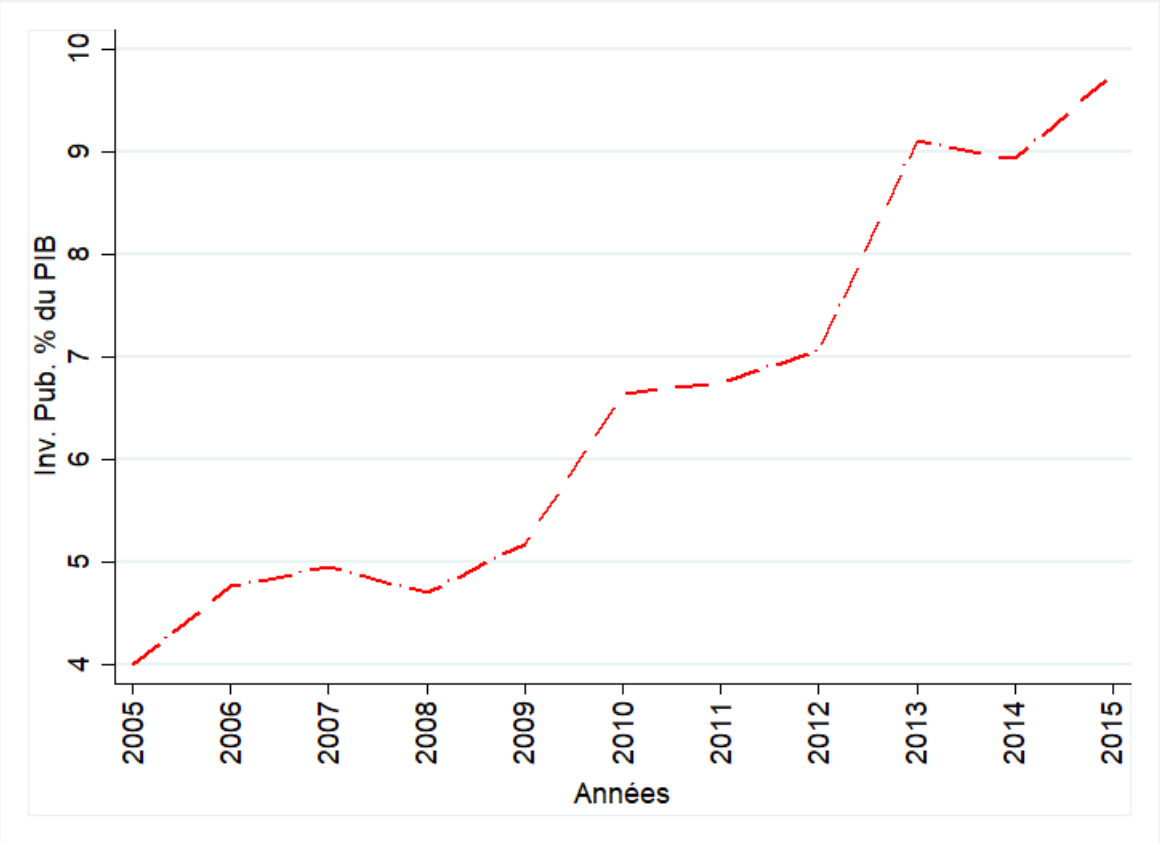
Chapter 4

Public Investment Efficiency in WAEMU zone: Do financing sources matter?.

4.1 Introduction

West African Economic and Monetary Union (WAEMU) countries have committed in large public investment programs since the beginning of the century. These commitments have led to a significant increase of public investment to GDP ratio, jumping from 4.0 percent in 2005 to 9.8 percent in 2015.

Figure 4.1 – Public investment to GDP ratio in WAEMU zone



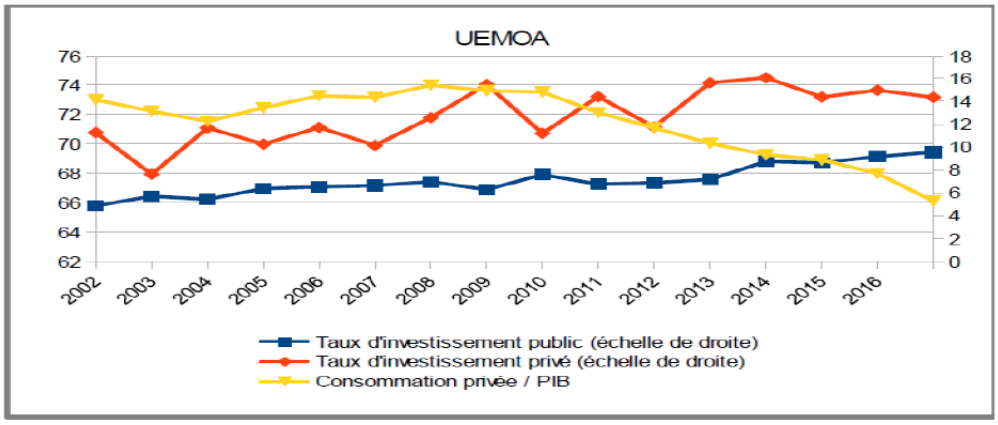
BCEAO data, author's calculations.

This sharp increase shows the willingness of WAEMU countries to fill the crucial gap in infrastructure. According to the International Monetary Fund (IMF) report[1], the States of WAEMU have a relatively low level of infrastructure development relative to some countries in Sub-Saharan Africa such as Ghana, Kenya, Malawi and Rwanda, especially in energy,

[1]See Barhoumi et al. 2016 "Efficience de l'investissement public dans l'UEMOA : évaluation empirique" in "UNION ÉCONOMIQUE ET MONÉTAIRE OUEST-AFRICAINE", IMF report No. 16/98.

transport and telecommunications sectors. In a context of weak mobilization of fiscal resources, countries rely usually on expensive loans to finance their investments. This leads to an increase in the budget deficit and debt, that is sharply increasing after the reductions obtained with the Heavily Indebted Poor Country (HIPC) program and Multilateral Debt Relief Initiative (MDRI). This rise in fiscal deficit and debt could become problematic if public investment is not efficient enough to boost growth and generate revenue to meet these commitments. In addition, the growing use of debt, particularly on the regional market for public debt, could strongly impact the macroeconomic framework, through increasing the sovereign risk. In addition, the constant trend (or even downturn trend) of private investment, as a percentage of GDP, in the WAEMU zone, over 2007-2016 period, raises questions about the ability of public investment to stimulate growth.

Figure 4.2 – Private and public investment in WAEMU zone



BCEAO data, author's calculations.

It therefore seems useful to analyze the efficiency of the public investment in WAEMU zone in order to gauge the profitability of these investments and their ability to offset the negative effects of increasing deficit and debt of the WAEMU states on their economies. The literature on public spending efficiency assessment is growing. Several papers provide international comparisons of public spending management in various economic sectors including education (Afonso and Aubyn, 2006b; Witte and López-Torres, 2017) and health (Grigoli and Kapsoli, 2013; Schwellnus, 2009) as well as multisectoral analysis (Herrera and Ouedraogo,

2018). Some papers focus on public investment efficiency. Dabla-Norris et al. (2012) develop a public investment management index (PIMI) based on four critical stages of the process of public investment decision namely the project appraisal, selection, implementation and evaluation. Gupta et al. (2014), drawing upon the PIMI index, compute an efficiency-adjusted public capital stock to reflect the quality of public investment. Moreover, IMF (2015) proposes the public investment management assessment (PIMA). This new index improves the PIMI by taking into account the macroeconomic framework of public investment decision such as fiscal rules, government component coordination, public-private partnership (PPP) monitoring as well as management of state-owned firms. Albino-War et al. (2014) use the data envelopment analysis (DEA) and free disposal hull (FDH) methods to compute public investment efficiency scores for Middle East and North Africa (MENA) and Caucasus and Central Asia (CCA) oil-exporting countries. They find that there is need to improve public investment management for these countries. IMF (2015) uses also a non-parametric frontier analysis for over 100 advanced, emerging and low-income developing countries. The comparison between the value of public capital (input) and measures of infrastructure coverage and quality (outputs) across countries reveals average inefficiencies in public investment processes of around 30 percent.

However, a small number of papers specifically has focused on WAEMU countries to evaluate the quality of public investment management. Soumaila (2014) analyzes the effectiveness of public investment in the Union using the incremental capital output ratio (ICOR) method. He finds that public investment in WAEMU is less effective than that of a group of peer countries. However, the use of ICOR reflects more the effectiveness than the efficiency of public investment. Barhoumi et al. (2018) assess the efficiency of public investment in WAEMU relative to a group of benchmark countries using the frontier efficiency method. They find that both quantity and quality of government investment remain low in the Union. However, they do not take two important issues into account.

First, they do not make a distinction between managerial and technological efficiency. While managerial efficiency refers to the ability to manage the resources in order to maximize the

output, technological efficiency describes the performance of the production model. In the context of public spending, technological efficiency refers to the performance of the environment that surrounds the public investment management. The distinction is quite important in the context of international cross-country comparisons with heterogeneity in the sample. Second, Barhoumi et al. (2018) paper, as well as other studies in the efficiency field, does not investigate the relationship between financing sources and efficiency. While institutional factors and government size are well known as determinants of government efficiency (e.g. Hauner and Kyobe (2010)), there is not empirical evidence of potential impact of financing sources on public spending efficiency. Although public investment is increasingly financed by public debt, we do not know how the composition of this debt, namely domestic (including regional debt) or external debt, impacts the quality of public spending. This issue is quite relevant for developing countries due to potential advantages of domestic debt (e.g Panizza (2008)) and especially in the context of WAEMU countries where there is support to use it (e.g. Guérineau and Guillaumont (2007)).

Using the meta-frontier analysis *à la* Huang et al. (2014), we investigate the efficiency of public investment in the eight WAEMU member countries over the period 2006-2015, insofar as these factors somehow determine the profitability of these investments and their ability to offset the negative effects of high debt of WAEMU states on their economies.

Our study contributes to the literature in two main points. First, we focus on the efficiency of one of the most dynamic regions in Sub-Saharan Africa in terms of public investment by disentangling the managerial efficiency (specifically technical efficiency) to the technological efficiency. Second, we highlight how the financing sources of investment impact its efficiency. Our findings suggest that WAEMU countries are less efficient than Sub-Saharan African and Asian reference countries. However, the decomposition of global efficiency into managerial and technological, unveils that WAEMU countries are more efficient than Sub-Saharan African countries in terms of technological efficiency. The assessment of financing sources denotes that external debt exerts more positive and significant effect on public investment efficiency than domestic debt. Conditionality related to external resource mobilization en-

sures their better management relatively to domestic debt that comes from regional market bonds, where some governments use long run resources to finance current expenditure. The rest of the paper is organized as follows. While Section 2 highlights key theoretical aspects, section 3 outlines the identification strategy. Section 4 depicts our baseline results and section 5 shows the robustness checks. At the end, Section 5 concludes and puts forward some policy recommendations.

4.2 Theoretical foundations

4.2.1 Crowding in - crowding out effects: efficiency paid attention

Government spending has two theoretical impacts on economic growth and private investment. The first concept is the crowding-in effect of Barro (1990). Indeed, he investigates the impact of tax-financed public spending on output and private investment. Basically, he finds that an increase in public spending, through higher income taxes, adversely affects after-tax return on private investment and as such reduce growth. Dividing public spending into productive (e.g infrastructure, electricity.) and unproductive (e.g government consumption) expenditure, Barro shows that unproductive spending negatively impacts growth while productive spending has positive effect on economic activity if growth effects stemming from increase of private capital, due to productive spending, outperform the adverse effects of higher taxes on output growth. Crowding-in effect between public and private investment could arise through various channels.

First, public investment could lead to increase the marginal productivity of private investment inputs. The presence of public infrastructure, such as transportation, energy, telecommunications, etc. could increase the expected rate of return on, as well as the demand for, labor and capital by the private sector. More specifically, the expected return value to build a plant appears to be much higher whether government has already made investment in electricity generation center, high quality roads and telecommunications. Several papers provide empirical evidence for this channel, especially in developing countries (Albala-Bertrand and

Mamatzakis, 2004; Reinikka and Svensson, 2002; Richard, 2004). Alternatively, public investment could contribute to the increase in private investment through adjustment costs. According Agénor and Moreno-Dodson (2006), adjustment costs typically represent frictions that prevent firms from adjusting their capital stock fully and instantaneously in response to, say, a demand shock, a change in the relative price of capital, or an increase in productivity. An expansion in the road network, for example, may not only reduce congestion on highways and ease the shipment of goods across regions (thereby reducing unit production costs) but also reduce expenses associated with the construction of a new factory or the transportation of heavy equipment for installation to a new, remote production unit. In doing so, the reduction of production and adjustment costs related to public investment will increase expected return value and boost private investment. Tybout (2000), Reinikka and Svensson (2002) (in Uganda), amongst others, show evidence of this channel, especially in low income countries.

The second theoretical effect of government spending is the crowding-out effect. Indeed, the idea is that government spending reduces the amount of money available for private investment, and as such reduce the productivity of spending on growth. Several channels can explain this relationship. The first mechanism of crowding-out effect is the distortionary taxes. The financing of public investment may lead to introduce distortionary taxes in the economy. These taxes may induce incitation for private agents to tax evasion, and/or reduce their propensity to invest through the reduction of the net expected return value of private capital. The second mechanism of crowding-out effect relies on the financing of public investment through loans on domestic markets. Increase credit demand for public investment on the domestic markets would lead to higher domestic interest rates or a potential rationing of credit to the private sector.[2] Further, if the public borrowing to finance public investment affect the sustainability of public debt over the time, whatever external or domestic debt used, the risk premium related to the interest rate may go up. As such, private capital may

[2]As pointed out by Agénor and Moreno-Dodson (2006), in a small open economy with open capital markets facing a fixed world interest rate, crowding-out effects through a rise in domestic interest rates cannot occur.

be reduced due to the increase in the cost of capital. Empirically, several evidences have been found in the literature. Argimon et al. (1997) find that public investment is negatively correlated with private investment for 14 OECD countries over 1978-89 period. Dhumale (2000) finds also, on a sample of 19 Middle East and North Africa countries over 1980-1998 period, a crowding-out effect of public investment only in oil exporting countries. Everhart and Sumlinski (2001), on 63 developing countries, find a negative relationship between private and public investment, with a stronger effect when corrected for corruption. All in all, we understand that the literature has not led to the consensus view of potential effect on public investment on economic growth through private investment stimulus. In this context, it appears crucial to determine how much public investment is productive for growth. Indeed, Pritchett (2000) and Caselli (2005) unveils that only a fraction of public investment is translated into public capital and is able to be productive. The authors questioned the large positive effects of public investment on growth, that has been found in the empirical studies. Pritchett (2000) outlines that the use of investment rate or Cumulated Depreciated Investment Effort (CUDIE) leads to overestimate the impact, because this indicator does not take the efficiency of public capital into account. The assessment of efficiency of public investment seems crucial to gauge the productive effect of public investment on growth. Hulten (1996) demonstrate that about one-quarter of the differential growth rate between Africa and East Asia countries can be attributed to inefficiency use of infrastructure in Africa.

4.2.2 Determinants of government efficiency, debt and public management

The literature on government efficiency provide evidence of substantial differences between countries and regions, regardless of income level (e.g. Afonso et al. (2010); Herrera and Pang (2005)).

To understand these cross-country disparities, a recent literature has begun to investigate the determinants of public efficiency. Afonso and Aubyn (2006a) assess the factors underlying the efficiency differences of education spending efficiency in OECD. They show that education

level of parents and household wealth lead a large share of the variation. Afonso et al. (2010) find that income level, education, quality of civil service as well as property rights enforcement influence the efficiency of public sector in the new members of the European Union. Hauner (2008) examines potential factors that influence the spending efficiency of Russian regions. He concludes that better institutions, low share of federal transfers in subnational government revenue, higher per capita income as well as small size of public spending are positively correlated with strong government efficiency. Hauner and Kyobe (2010) find that higher public spending to GDP ratio is correlated with low efficiency in health and education sector for 114 developing, emerging and developed countries over 1980-2004 period. Focusing on public investment, Herrera and Ouedraogo (2018) highlight that public capital efficiency is positively correlated with regulatory quality and negatively associated with perception of corruption. These results are in line with those of Albino-War et al. (2014) and Barhoumi et al. (2018).

However, this literature on the determinants of efficiency differences ignores the potential effects of financing sources, especially the trade-off between domestic and external debt to finance government investment. Both domestic and external debt can influence the management of public spending. With the reduction of foreign direct investment and the insufficient of resource mobilization, most of developing countries use debt to finance their public investment.

Domestic borrowing can improve the efficiency of overall investment and increase the total factor productivity. Most of banks in developing countries are reluctant to provide loans to private sector due to risk-aversion and lack of predictability of business environment. As such, banks invest mostly in consumption related to trade activities instead of providing long-run financing to strategic sectors, including agriculture and manufacturing (e.g. Pattillo et al. (2006)). Representing a safe and steady income, government bonds can act as collateral and mitigate the aversion of banks to private agents. Put it differently, holdings of public debt may offset the lack of strong legal and corporate environments (Abbas and Christensen, 2010; Kumhof and Tanner, 2005).

External debt can also affect quality of public management essentially through conditionality. External debt usually comes with conditionality. Several mechanisms support the presence of conditionalities in debt design. One of them is the commitment channel. This idea emerged following the 1980s debt-crisis. One lesson of this crisis is that high levels of public debt could be associated with inefficient outcomes. This is usually due to debt-overhang. More explicitly, heavily indebted governments face low incentives to increase their reform efforts and achieve higher future incomes. These incentives come from the fact that they would have probably to transfer an important share of future gains to creditors. As such, this strategy can lead to lessen debt repayments and induce a Laffer curve of debt. Two solutions have been highlighted in the literature to deal with this issue, namely debt rescheduling or/and debt relief (e.g. Diwan et al. (1992)). However, credible solutions can work only and only if debtors commit to strictly implement policy agenda to raise future income in exchange of reconsidering debt obligations by creditors. Conditionality can act as the mechanism by which indebted governments could commit to credible policies and as such lead to find a solution to stop the debt-overhang trap. Without conditionality and restructuration of debt, high level of debt may persist and may induce rationing of credit (Fafchamps, 1996; Sachs, 1989).

4.3 Methodology

4.3.1 Identification strategy

Most of the previous cross-country comparisons considers some homogeneity of the production technology of government on different sectors such as health, education, and infrastructure (Evans et al., 2000; Herrera and Pang, 2005; Jayasuriya and Wodon, 2003).
In doing so, they implicitly suggest that every country in the sample has the same capacity, mechanism or "technology" to turn public spending (inputs) into specific outcomes (outputs). This assumption might be problematic given the diversity of countries in terms of development stage, geographic conditions, business environment, etc. The estimation of efficiency

score under homogeneous technology could lead to country performance bias. We then make a new assumption of the heterogeneity of production function through the introduction of metaproduction function.

As first introduced by Hayami (1969), the metaproduction function is based on the idea that all producers in the various production groups have potential access to an array of production technologies, but each may choose a particular technology, depending on specific circumstances, such as regulation, environment, production resources, and relative input prices. These conditions inhibit decision-making units in some groups from choosing the best technology from the array of the potential technology set. A production technology gap is the difference between the best technology and the chosen sub-technology, i.e., the group-specific frontier.

In this paper, we attempt to compare the efficiency of WAEMU countries to selected Sub-Saharan Africa and Asian countries. WAEMU zone includes countries that have experienced strong and rapid growth in the last decade, mainly based on agriculture and mining sector. They have also undertaken huge investment plans with aiming to achieve the level of emerging countries. We compare this group of countries with peer countries in Sub-Saharan Africa and Asia. Although having more or less the same growth rates over the last decade (see appendix), Sub-Saharan African countries (Gambia, Ghana, Namibia and Zambia) and Asian countries (Bangladesh, China, India, Indonesia, Malaysia, Philippines and Thailand) also have specific characteristics which are distinct from those in the WAEMU zone. Indeed, the three categories of countries have different organizations and mechanisms for the implementation of investment projects. This difference of "culture" in public management as well as constraints in each group leads us to assume a heterogeneity in groups of countries. The business environment as well as the rules in terms of management and resources allocation of countries like India and China are very different from those of WAEMU countries. These differences between groups of countries can be seen as technological inefficiency. To sum up, we consider two types of efficiency, namely managerial and technological efficiency. Managerial efficiency encompasses technical and allocative efficiency. While the former is a ability

to avoid waste in the production process, the latter refers to an optimal mix of inputs given their respective costs and the production technology. We are more interested in the technical efficiency than allocative efficiency. First, our aim is to gauge the capacity of policymakers to put "the right coin to the right place with the right way". We are convinced that the technical efficiency fits this objective. Second, the estimate of allocative efficiency requires information on price structure of inputs. The evaluation of prices of public sector inputs seems to be a very complicated task due to the feature of inputs and inconsistency of price information across countries. Technological efficiency refers to a measure of the performance of group-specific production function relative to the best performance.

To reach our objective, our estimation strategy relies on the stochastic metafrontier approach following Huang et al. (2014). Initially developed by Battese et al. (2004) and extended by Huang et al. (2014), metafrontier analysis assumes a heterogeneity in the technology between countries. This consists to disentangle the technical efficiency to technological efficiency. This approach displays the advantage of decomposing the overall country efficiency into technology gap ratios (TGRs), measuring the distance between the selected technology and the best available one, and the technical efficiency of countries using the selected (group) technology.

The estimation consists of two steps. First, a stochastic frontier is estimated for each group of countries and the technical inefficiency is derived. It is assumed here that the production technology is roughly the same for all countries in the same group.

Government production is as follows:

$$Y_{it} = f(X_{it}, \beta^s).e^{-U^s_{it}+V^s_{it}} \tag{4.1}$$

Where Y_{it} is the output, $f(.)$ represents the technology function. While X_{it} is the vector of inputs, β^s represents the vector of technology parameter. Following the standard stochastic frontier estimation, the error term is divided into V^s_{it} the statistical noise and U^s_{it}, the one side error term capturing the managerial inefficiency. We assume a half normal distribution for the inefficiency. We estimate equation 1 using the maximum likelihood and derived the inefficiency term using the Jondrow et al (1982) approach.

In the second step, the meta frontier estimation requires to envelop all countries in all groups. For that, we predict the maximum output value from the first step $\widetilde{Y_{it}} = f(X_{ii}, \widetilde{\beta^s})$ and then estimate the stochastic meta frontier using Hang et al (2014) algorithm.

$$\widetilde{Y_{it}} = f(X_{ii}, \beta^M).e^{-U_{it}^M + V_{it}^M} \tag{4.2}$$

The difference between O'Donnell et al. (2008) and Huang et al. (2014) relies on the estimation of the noise term V_{it}^M. While the former is a deterministic approach with estimation by linear programming method and attributes all the inefficiency to the residual term, the latter hinges on the statistical estimation and disentangles the random noise ("bad luck") to the inefficiency term. This is especially important when you analyze the public spending quality. Some external shocks such as natural disasters, terrorism, etc may affect the transmission between inputs and outputs, independently of the government. Huang et al. (2014) argue that the introduction of the random noise improves the estimation process since the maximum outputs are not observed but estimated in the deterministic strategy. U_{it}^M designs the technology gap between the country-specific boundary and the technology boundary. U_{it}^M is then extracted using the jondrow et al 1982 process.

4.3.2 Data, peer countries selection and limitations

We estimate the efficiency of public investment of WAEMU countries over 2006-2015 period. The choice of the period has been restricted by the availability of data. To estimate the efficiency, we consider a simple one input - one output model. Although do not exempt from criticisms, this specification ensures the comparability of our analysis with the literature on public sector efficiency that widely draws upon this model (Albino-War et al., 2014; Herrera and Ouedraogo, 2018; IMF, 2015). Indeed, This specification could generate a potential variable problem omitted, which could bias the estimation of the efficiency scores. As input, we use the public investment to GDP ratio. This variable measures the amount of investment spent by a government for a given year, in percentage of GDP. As output, we consider the quality of infrastructure of the World Economic Forum. This indicator is a survey-based

index built on the World Economic Forum (WEF) pillar 2 sub-components focusing on the quality of key infrastructure services.

To compare the performance of WAEMU countries, two groups of reference countries are selected. While the first group includes Sub-Saharan African countries, the second group includes Asian countries. The list of countries is as follows:

Sub-Saharan African countries: Gambia, Ghana, Namibia, and Zambia;

Asian countries: Bangladesh, China, India, Indonesia, Malaysia, Philippines, and Thailand.

The choice of benchmark countries was based on existing literature and their socio-economic proximity with WAEMU countries. Regarding the existing literature, papers on efficiency of public investment in the WAEMU used a set of countries as a benchmark for comparison. Barhoumi et al. (2018), selected some Sub-Saharan African countries such as Gambia, Ghana, Namibia, Rwanda and Zambia; as well as some Asian countries like Bangladesh, China, India, Indonesia, Malaysia and the Philippines as benchmark groups. Barhoumi et al. (2018) considered Botswana, Ethiopia, Mauritius, Mozambique, Rwanda, Tanzania and Uganda as peer countries in its paper.

Regarding socio-economic proximity, the selected countries are relatively close in terms of economy growth over the last decade. Indeed, the rate of average growth of the WAEMU countries between 2005 and 2015 is 4.40%, that of the countries of sub-Saharan Africa is 5.65% while that of Asian countries is 6.1%. Analysis of the standard deviations of these average growth rates reveals a dispersion of 2.65 for WAEMU countries, 2.75 for Asian countries and 3.01 for African countries (see appendix).

Moreover, it must be recognized that the choice of reference countries involves a share of subjectivity. However, it ensures the comparability of our analysis with the previous literature that draws upon this country's selection. The choice of countries with similar growth path to WAEMU countries try to ensure the comparison of public investment management amongst countries with high growth dynamic.

4.4 Results

This section displays our baseline results on efficiency scores. While table 4.1 displays technical efficiency by country and regions, table 4.2 shows technology gap across regions.

Table 4.1 – Technical efficiency per country and region

	Country	Technical efficiency	Group mean
WAEMU	Cote d'Ivoire	91,1%	84,9%
	Senegal	87,4%	
	Burkina Faso	86,9%	
	Benin	85,4%	
	Mali	73,9%	
ASS	Namibia	91,7%	88,7%
	Ghana	90,6%	
	Gambia, The	89,0%	
	Zambia	83,3%	
Asia	China	97,7%	91,0%
	Bangladesh	96,1%	
	Malaysia	91,4%	
	Thailand	91,4%	
	India	88,5%	
	Philippines	87,4%	
	Indonesia	84,5%	

WAEMU zone appears to be, on average, the less efficiency region with 84.9% of technical efficiency score in public investment relatively to peer Sub-Saharan African (88.7%) and Asian (91.0%) countries over 2006-2015 period. In other words, these findings show that WAEMU countries could improve the quality of infrastructure by 15.1% with the same amount of investment spending. Similarly, peer Sub-Saharan African (Asian) countries could improve their quality of infrastructure by 11.3% (9%) only with better public management. Our results are in line with previous literature, including those of Barhoumi et al. (2018), Dabla-Norris et al. (2012) and Soumaila (2014).

More specifically, Cote d'Ivoire and Senegal appear to be the best performing economies, with 91.1% and 87.4% respectively, in terms of management of factors relating to public investment.

Côte d'Ivoire's results are better than those of the benchmark group of Sub-Saharan African countries with the exception of Namibia. These results could be explained by the remarkable performances registered by Côte d'Ivoire since the end of the socio-political crisis. In addition, Côte d'Ivoire and Senegal have put in place several institutions related to investment management, such as the Fund Road Maintenance (FER) in Senegal and Côte d'Ivoire and the Energy Support Fund (FSE) in Senegal. These structures aim at ensuring rigorous investment monitoring in the dedicated sectors. In addition, the quality of public administration in these countries can explain these findings. Indeed, Senegal, for example, had the best administration of the Union with a score of 3.5 out of 6, over the period under review, according to the World Bank's CPIA quality of public administration index. On the other hand, Mali achieves the weakest performance, with an inefficiency score of more than 25%. This result, although alarming, can be understood by socio-economic unrest and security troubles with terrorism and state instability over the period. This situation has led to additional expenditure to strength security measures.

Still in the efficiency analysis, it is interesting to take a look at another type of inefficiency: this is the technology gap (or technological efficiency). Indeed, very few studies have investigated public spending quality through analyzing the technology gap. Table 4.2 presents the average technological efficiencies over regions. Results show that efficiency score of WAEMU countries, on average over the period, is 95.9%. This score is higher than that of Sub-Saharan African countries, which is 93.9% but still lower than the efficiency of Asian countries which stands at 96.1%. WAEMU countries are technologically more efficient than peer countries in Sub-Saharan Africa. In other words, WAEMU countries seem to offset their managerial inefficiency with technological efficiency. More explicitly, WAEMU countries try to improve the business environment in which public investment are implemented and overcome constraints that hinder the impacts of investment into economy. These include improving the business

Table 4.2 – Technology gap across regions

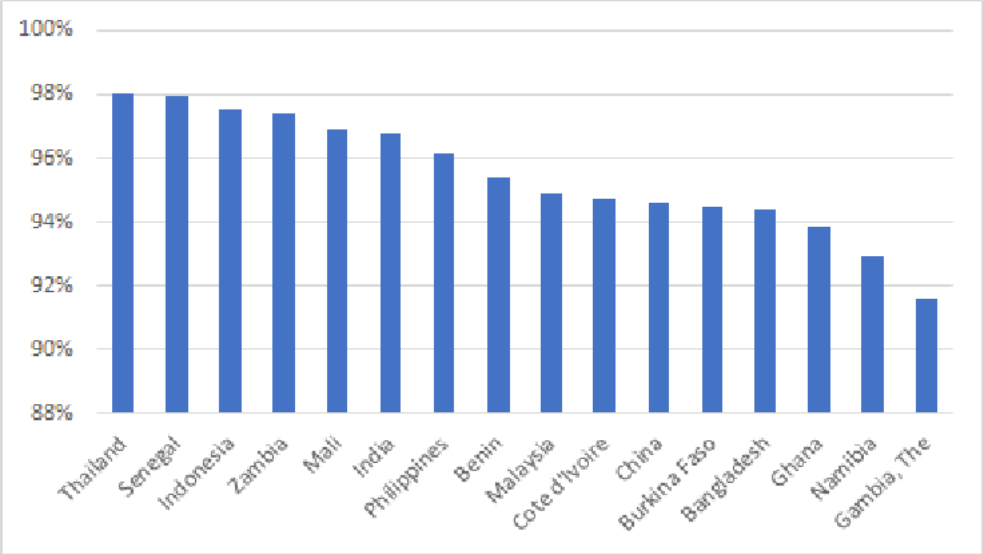
	Technological Efficiency
Mean WAEMU	95,9%
Mean ASS	93,9%
Mean Asia	96,1%

climate and the fight against corruption. Indeed, the World Bank Doing Business 2015 report, "Going Beyond Efficiency" finds that five Sub-Saharan African countries including four WAEMU countries, namely Senegal with a score of 161, the Benin (151), Togo (149) and Côte d'Ivoire (147) are amongst the top ten of countries with the most progress in improving business regulation out of 189 economies. It is noteworthy that our peer African countries are including in the ranking.

At a more granular level, figure 4.3 displays technological efficiencies by country. While Senegal leads with an efficiency of 97.9%, ahead of Mali (96.9%) and Benin (95.4%). These results are explained by the important progress that these countries have made in the area of governance, business environment and corruption fighting. Indeed, the Transparency International 2015 corruption index ranking unveils that Senegal is doing better than other countries in WAEMU to reduce corruption. In the same line, the 2016 Doing Business report has ranked Mali as the best improvement in the governance sector between 2015 and 2016 amongst WAEMU countries. While Benin has made significant progress in governance; acknowledged by the score of 3.5 out of 6 from the CPIA 2015 evaluation, Côte d'Ivoire has performed less better with a score of about 3.3. This is translated into the performance of those countries in terms of technological efficiency. Further, Burkina Faso is at the bottom of distribution with technology efficiency score of 94.4%.

After estimations of technical and technological efficiency, we can compute the overall efficiency score. According to Huang et al (2014), the overall efficiency score or metafrontier technical efficiency (MTE) is the product of technical and technological efficiency. Table 4.3 displays the overall efficiency score by regions. WAEMU is still globally the less efficient (81.4%) region relative to Sub-Saharan Africa (83.3%) and Asia (87.4%).

Figure 4.3 – Technology efficiency per country



BCEAO data, author's calculations.

Table 4.3 – Overall efficiency by region.

	Overall efficiency
Mean WAEMU	81,1%
Mean ASS	82,9%
Mean Asia	87,4%

Several factors could help to understand these results. First, the allocation of public investment in the different sectors is not always optimal in developing countries. Indeed, Calderón and Servén (2010) explain that most of low-income countries do not invest into sectors with high potential to increase economic growth and productivity. Second, although the indicators of good governance and corruption have improved, WAEMU countries still have the lowest scores in these sectors. Collier and Venables (2008) argue that the lack of investment assessment in developing countries negatively affects their efficiency. Third, the lack of maintenance of infrastructure is a factor of inefficiency. Only some countries in WAEMU have state owned enterprises (SOEs) related to infrastructure management in different sectors, like Cote d'Ivoire and Senegal. Even when these SOEs exist, they are either fledgling either without solid experience. Dabla-Norris et al. (2012) highlight the importance

of institutions in the inefficiency of public investment. They compute an indicator that takes into account four institutional dimensions including appraisal, selection, execution and evaluation of projects. Regarding the countries of the Union, the ranking is the same as that of managerial efficiencies with Côte d'Ivoire (86.8%) and Senegal (85.7%) at the top of the list, followed by Burkina Faso (82.0%), Benin (81.3%) and Mali (71.42%).

4.5 Robustness

Our baseline estimates focus on parametric frontier approach. Indeed, our stochastic frontier analysis (SFA) relies on very simple one output-input specification through maximum likelihood estimation. Several issues could bias results stemming from econometric approach. First, the use of one input-output approach could lead to the non-convergence of the estimator through potential omitted variable issue. Second, SFA requires strong assumptions on the distribution of inefficiency. Although half-normal distribution seems to be consistent with our data, other assumptions could be considered.
To check the sensitivity of our results to the econometric model, we re-estimate efficiency scores with non-parametric approach, especially using data envelopment analysis (DEA). This model is based on a linear programming and uses very precise iteration algorithms. The theoretical model the most used is that of Farrell (1957) while the estimation process relies on Coelli et al. (1998). We use the non-parametric metafrontier analysis developed by O'Donnell et al. (2008).

We present only overall efficiency estimate, as it is a summary of the technical and technological efficiency. Table 4.4 displays the results. As expected, public investment in WAEMU countries is less efficient than those of sub-Saharan Africa and Asia. The relatively low efficiency scores are due to the absence of the stochastic error term in the deterministic estimate which attributes the entire difference from production to inefficiency.

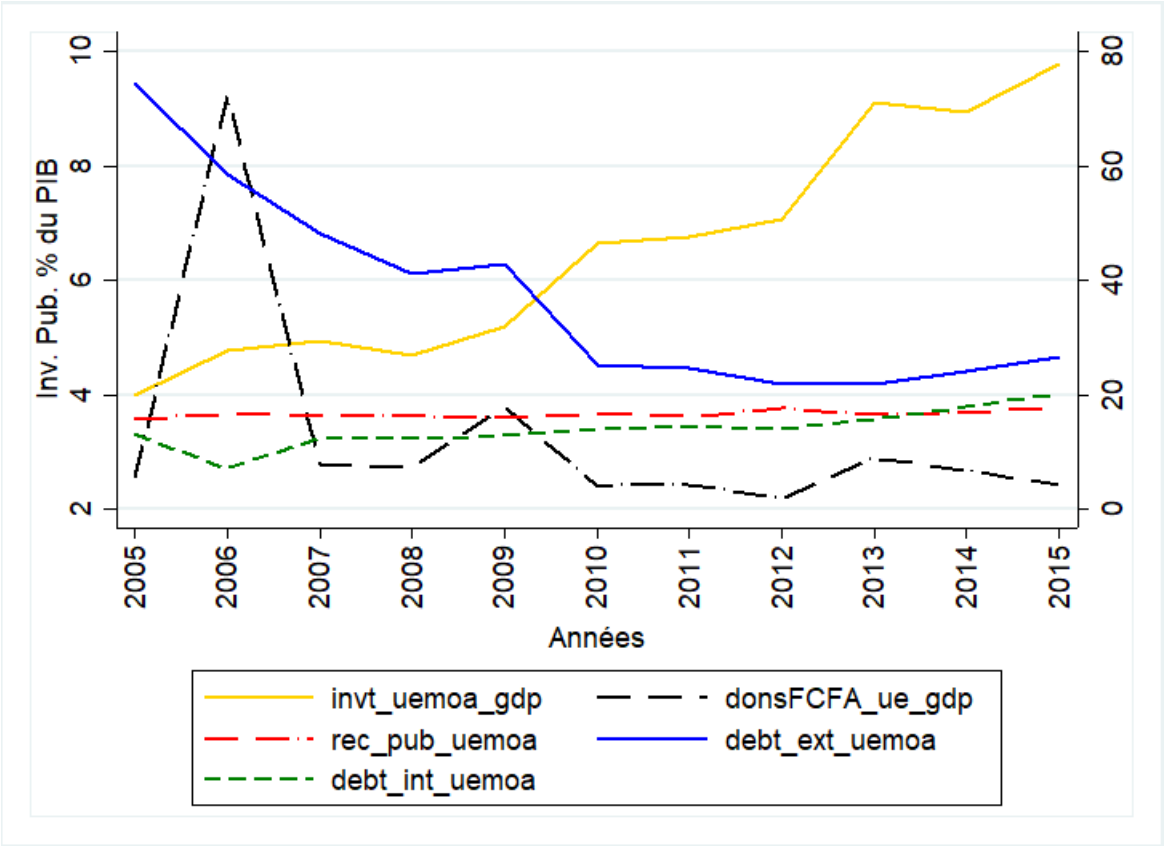
Table 4.4 – Overall efficiency score using non-parametric approach

	Country	Overall efficiency	Group mean
WAEMU	Benin	53,5%	76,5%
	Burkina Faso	62,8%	
	Cote d'Ivoire	100,0%	
	Mali	82,1%	
	Senegal	83,9%	
ASS	Gambie	98,5%	77,1%
	Ghana	83,8%	
	Namibie	76,9%	
	Zambie	49,2%	
Asia	Bangladesh	66,8%	81,1%
	China	48,5%	
	Indonesie	92,2%	
	Malaisie	100,0%	
	Philippines	100,0%	
	Thailand	87,7%	
	Inde	72,2%	

4.6 Financing sources and public investment efficiency

Public investment requires significant resources. Countries have four main potential sources, namely, domestic revenue, external and domestic debt as well as aid. figure 4.4 displays the trend of financing mode and public investment in WAEMU zone. It appears that external borrowing (debt_ext_uemoa), has decreased from 75 % of GDP in 2005 to 21.9 % in 2012, thanks to the debt relief through the initiative for Heavily Indebted Poor Countries (HIPCs) and the Debt Relief Initiative Multilateral (MDRI). However, an upturn trend has been observed in external debt since 2012 with an increase from 21.9 % in 2012 to 25.8 % in 2015. In the meantime, the domestic debt (debt_int_uemoa) shows a continuous rise, from

Figure 4.4 – Public investment and financing sources in WAEMU



BCEAO data, author's calculations.

13.1 % of GDP in 2005 to 20 % in 2015. Domestic revenue (rec_pub_uemoa), meanwhile,

remained constant over the period and is below 20 %. In addition, aid to GDP ratio (dons-FCFA_ue_gdp) fluctuated during the period with a peak in 2006 and 2009 of respectively 9.22 % and 3.8 % of GDP. However, it remains on a downward trend and reached 2.4 % in 2015. This simple analysis highlights, in a context of low resource mobilization tax, the predominant use of internal and external loans to finance public investment. This increase in debt, as such in public deficit, could become problematic whether public investment is not sufficiently efficient to increase growth and produce enough revenue to repay debt. In addition, the increasing use of debt, particularly on the regional market for public debt, could strongly impact the macroeconomic framework of the States of WAEMU, through the increase in sovereign risk which could weigh on financial stability. After estimation of investment efficiency scores, we investigate what are the potential determinants of this efficiency. Several recent studies have attempted to highlight a set of determinants of efficiency. Albino-War et al. (2014), working on MENA and CCA countries, show that a high level of efficiency of public investment is associated with a good quality of institutions and a low level of revenue from natural resources. They also find that official development assistance (ODA) does not have a significant impact on efficiency. Barhoumi et al. (2018) investigate the effects of institutional and economic factors on efficiency of public investment in the WAEMU. They find that the quality of regulation has a positive impact on efficiency while the dependence of natural resources is associated with low efficiency.

However, none of the previous studies investigates the impact of the financing sources of public investment on their efficiency. It is rationale to think that the conditionality or not associated to the different means to finance public investment can impact the way on which governments will manage and increase the productivity of these investments. We then estimate a tobit model to investigate the determinants of public investment efficiency in WAEMU zone, especially how the composition of investment financing matters to improve their efficiency. While our dependent variable is the efficiency score, we consider external debt (ldebt_ext), domestic debt (ldebt_int), aid (ldons_gdp), private investment (lipriv_gdp), the quality of regulations (RQ), public revenue, excluding grants, (lrec_pub_gdp) and nat-

ural resources revenue (lress_nat_gdp) as explanatory variables. We report these variables in GDP ratio. Table 4.5 reports our results.

Table 4.5 – Determinants of public investment efficiency in WAEMU

	(1)	(2)	(3)
	eff_ue01	meta1	eff_ue_global1
ldebt_ext	0.123***	-0.00188	0.105***
	(3.12)	(-0.20)	(3.36)
ldebt_int	0.0398	0.00796	0.0439*
	(1.38)	(1.18)	(1.90)
ldons_gdp	-0.0644***	0.0112**	-0.0382**
	(-3.31)	(2.53)	(-2.61)
lipriv_gdp	-0.321***	0.0799***	-0.214***
	(-4.30)	(4.48)	(-3.57)
RQ	0.429***	-0.0304	0.347***
	(5.01)	(-1.45)	(5.08)
lrec_pub_gdp	-0.210	0.0711**	-0.0799
	(-1.39)	(2.03)	(-0.68)
lress_nat_gdp	-0.0706**	0.0131	-0.0543*
	(-2.09)	(1.65)	(-1.99)
_cons	2.141***	0.505***	1.425***
	(4.99)	(4.98)	(4.31)
sigma			
_cons	0.0825***	0.0214***	0.0677***
	(8.56)	(9.06)	(9.27)
N	43	48	43
Pseudo-R2	-0.907	-0.213	-0.427
Khi2	34.79	34.72	32.80

In terms of technical efficiency (eff_ue0), we find that external debt has a positive impact (+0.12) on the efficiency score (table 4.5) while domestic debt coefficient appears positive and not significant. On the one hand, financing coming from external debt increases the probability of having investment with high return value for economy. This could be due to the conditionality associated to external debt by traditional donors. Conditionality usually refers to a set of criteria, rules, outcomes or reimbursement agenda on which debtors and creditors should agree on before the lending. Strict commitments before lending could lead to better management of the resource. On the other hand, the result of domestic debt im-

pact could imply that financing from the regional public debt market are not always used optimally. Indeed, it has been observed that some countries use long run resources (issues of public bonds) to ensure short-run current spending. Moreover, aid (-0.06), private investment (-0.32) and natural resources (-0.07) negatively impact the efficiency of public investment. Our results are in line with previous literature. Indeed, the adverse effect of ODA are widely highlighted in the literature of effectiveness of aid in developing countries. Investment financing by aid, almost free, can lead to laxity in the management of investment relatively to that of loans. Regarding the effect of private investment, we highlight the crowding-out effect between private and public investment (Turrini, 2004). An increase in private investment, especially in sectors whose investment was traditionally the responsibility of government such as infrastructure, energy and transport, encourages governments to be less demanding on the performance of their investments. Regarding the natural resources, the results are in line with those of Barhoumi et al. (2018) and Albino-War et al. (2014). Governments with low quality institutions use revenues from natural resources as a rent to influence the political choice of population; which leads to inefficient spending (Grigoli and Mills, 2014; Keefer and Knack, 2007). Gelb and Grasmann (2010) also find that natural resources revenue volatility leads to low quality of public expenditure in main exporter countries. In addition, the quality of regulation (+0.43), unsurprisingly, positively impacts the managerial efficiency scores of countries in WAEMU. It appears with the highest coefficient, reflecting the key role of good institution to get high quality management of public investment.

In terms of technological efficiency (meta1), three key results emerge from the estimation. First, aid positively (+0.01) contributes to the reduction of technology gap. This result makes sense as the two efficiencies do not reflect the same reality. Technological efficiency, as mentioned above, expresses the idea of improving the business and conditions under which public investment will thrive. This is mainly through improving governance and fighting corruption. In this regard, aid could serve as a key instrument in the sense where aid allocation, WAEMU zone, is generally subject to conditions of good governance and corrup-

tion reduction such as the World Bank aid programs. Second, private investment enhances technological efficiency with a positive coefficient of 0.08. Good doing business environment as well as strong institutions are crucial to attract foreign investments, that represent a considerable share of private investment in Africa. As a result, more private investment will lead governments to improve conditions in which public investment evolves and the mechanisms by which they impact the economy. Third, government revenues contribute to improve the technological efficiency. Enough own resources of a country could contribute to strengthen the setup of strong monitoring and management system such as Integrated Management Systems or digitalization of public administration.

For the overall efficiency (eff_ue_global1), the results are qualitatively the same as those of managerial efficiency, except the positive and slightly significant effect of domestic debt. Relative to the coefficient on external debt, which is 0.10, the impact of domestic debt, with a magnitude of 0.04, is relatively small. Although these results show external debt as more efficient than internal debt on the efficiency of public investment, the message of our paper is quite different. Indeed, external debt may have detrimental effects on the economy. First, external borrowing appears to be procyclical, volatile and unpredictable (Calvo et al., 2005). Second, external debt of developing countries is usually denominated in foreign currency ("Original sin"). This feature of external borrowing biases the evaluation of debt sustainability because an important share of debt service relies on the evolution of exchange rate, that is volative and sensitive to crises and shocks (Hausmann, 2004). Moreover, this could also lead to the volatility of capital flows and GDP growth (Eichengreen et al., 2005). Third, the debt repayment could affect the exchange rate by putting strong pressures on foreign reserves during reimbursement time.

Following these arguments, domestic debt could strongly improve the efficiency of public investment if regional and national bond markets strengthen the conditionality of this type of debt. This problematic is well explained by Panizza (2008) that highlights possible trade-off between domestic and external borrowing and points out that while the switch towards more domestic borrowing can play a positive role in reducing the risks of sovereign finance,

policymakers should not be too complacent. Guérineau and Guillaumont (2007), focusing on WAEMU countries, support the idea to a growing use of domestic debt. They outline that an increase in the domestic debt is not only possible, since there exists excess bank liquidity and that institutional constraints may be overcome, but also desirable since the main risks linked to the rise of public debt (debt distress, crowding out of private investment and real exchange rate appreciation) seem weak at the moment.

4.7 Conclusion and policy recommendations

The aim of this study is to analyze the efficiency of public investment in the countries of the WAEMU zone. Relying on metafrontier analysis of Huang et al. (2014), we estimate the public investment efficiency of the eight WAEMU countries over the 2006-2015 period. Our findings show that WAEMU countries, globally, are less efficient than those of the reference countries of Sub-Saharan Africa and Asia. However, the decomposition of overall efficiency, into managerial and technological efficiency, shows that WAEMU states do better than those in Sub-Saharan Africa in terms of technological efficiency. This means that the countries of Union offset their small technical capacity to manage investment resources with significant improvements in governance, against corruption and improvement of business environment in which public and private investment are implemented.

Regarding the effects of financing sources on efficiency, the results show that public investment financed by external debt seems more efficient than that of financed by domestic debt. Far from saying that external debt should be first use to finance public investment, the underlying message of our results is that the rules and conditions of domestic (regional) debt must be strengthened to ensure both monitoring and rigorous use of resources. In addition, aid stand out with either an insignificant or negative impact on efficiency public investment. This means that binding funding is preferable for public capital expenditure than more concessional financing.

The economic policy recommendations that may emerge from this study are the following:

(i) Countries should continue to improve the management of public investment through the

promotion of good governance and specific SOEs related to the management of public investment. Countries should put in place some certifications such ISO 9001 for organizations in charge of public spending management;

(ii) it is crucial to significantly improve the use of resources drawn from domestic debt, in particular through the regional public debt market. This can practically be done by creating a competition to resources access on the regional market. The more access to domestic debt is competitive and rigorous, the more it is expected that the resource will be used wisely. This competition could take the form of a rating grid and will integrate the factors of good governance and debt sustainability;

(iii) States must focus on other ways to increase investment such as facilitating access to credit, reducing administrative burden as well as promoting leadership and entrepreneurship. Moreover, the development of the doing business climate and the fight against corruption are key conditions to any investment performance and private sector development.

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4.8 Appendix

Table 4.6 – Economic characteristics of countries

Country	Public investment to GDP ratio (%)	Private investment to GDP ratio (%)	GDP growth (%)	Groups
Benin	4,5	12,5	4,3	
Burkina Faso	8,1	11,3	5,5	
Cote d'Ivoire	3,0	8,2	4,4	WAEMU
Mali	3,7	11,3	4,1	
Senegal	5,3	15,1	3,8	
Gambia	5,3	8,9	3,5	
Ghana	5,7	15,9	7,1	ASS
Namibia	7,6	23,9	5,0	
Zambia	4,9	25,9	6,9	
Bangladesh	5,7	15,6	6,2	
China	15,9	22,7	9,6	
India	6,0	19,8	7,6	
Indonesia	3,1	27,2	5,6	Asia
Malaisia	9,7	13,3	4,9	
Philippines	2,5	14,9	5,4	
Thailand	5,5	17,0	3,4	

Table 4.7 – Description of the variables

Variables	**Descriptions**	**Sources**
GI	Public investment in % of GDP	Authors' estimations based on (IMF, 2017)
QOI	Quality of infrastructure pilar 2 World Economic Forum index	World Economic Forum
ldebt_ext	External debt in % of GDP	IMF WAEMU report
ldebt_int	Domestic debt in % of GDP	IMF WAEMU report
ldons_gdp	Total aid in % of GNI	World Development Indicators
lpriv_gdp	Private investment in % of GDP	(IMF, 2017)
RQ	Quality of Regulation	World Development Indicators
lrec_pub_gdp	Government revenue % of GDP	IMF WAEMU report
lress_nat_gdp	Natural ressources rent % of GDP	World Development Indicators

Chapter 5

New Keynesian DSGE models for fiscal policy in Africa[1]

[1]This paper is joint work with Juste Somé (Department of Economics, Université Norbert Zongo, Koudougou, Burkina Faso) and Lacina Balma (Macroeconomics Policy, Forecasting and Research Department, African Development Bank, Abidjan, Côte d'Ivoire).

5.1 Introduction

Analysis of the effects of fiscal policy is a ubiquitous issue since the 1960s. While most of the literature attention focused on monetary policy as one of key drivers of short-run growth in 1980s, successive crises, especially the 2007-09 financial crisis, revived the debate around the importance and/or effects of discretionary fiscal actions on the economy through either fiscal stimulus packages (used to avoid another great recession) or fiscal consolidations (used to stabilize the fiscal deficit).

The literature on theoretical and empirical contributions to understand the role of fiscal policy on output is large and far from the consensus. The diversity in the nature and size of fiscal multipliers stems mainly from the methodology and identification framework implemented by academics.

One strand of the literature relies on the reduced forms methods, especially Vector Autoregressive (VAR) models, with various identification approaches. First, they assume that the government spending does not react to GDP and tax within a quarter. Consequently, these studies find an important impact of government spending on GDP as well as a crowding-in effect of consumption (e.g. (Blanchard and Perotti, 2002; Fatás et al., 2001). However, a deep look at into this literature shed light on different estimates of impact of government spending on GDP due to constraints related to the identifications of discretionary actions of government. Indeed, While Blanchard and Perotti (2002) find a government spending multiplier close to one, Fatás et al. (2001) outline an estimate greater than one. All these studies refer to the US economy. Second, some studies rely on the Ramey-Shapiro approach. This approach consists to use some war dates to identify unexpected increase in defense spending that are completely exogenous to the US economy. The idea is that the war episodes reflect the discretionary change in the fiscal policy and can be used as such. These papers find a relatively small effect of government spending on GDP and crowding-out effect of consumption (Burnside et al., 2004; Ramey, 2011; Ramey and Shapiro, 1999). However, Ramey (2011) shows that increases in military spending and non-defense spending are anticipated several quarters before they occur. Consequently, it is important to capture the timing of

the news about future increases in government spending. Her multiplier estimates based on an extension of the Ramey and Shapiro (1999) "war dates" and new data series on defense news lie between 0.6 and 0.8 when World War II is excluded, and near unity with World War II included. Similar empirical findings are reported by Barro and Redlick (2011). However, one lesson of the above literature is that it is important to account for the timing and nature of anticipations to estimate the fiscal policy effects.

A second strand of the literature relies on structural macroeconomic models, more specifically on the Dynamic Stochastic General Equilibrium (DSGE) models. DSGE models present two main advantages compared to reduced forms models. First, these models include in their structure underlying micro-foundations, allow for model consistent expectations and provide a relative credible answer to the Lucas critique. Second, the shocks in DSGE, understood as the description of exogenous processes, provide direct economic interpretations compared to VAR models where there is need to identify exogenous shocks indirectly through reduced form residuals. The use of DSGE models has dramatically increased in the recent years, both for fiscal policy and monetary policy analysis.

Regarding fiscal policy analysis, we can distinct two leading theories that influence the magnitude of fiscal multipliers using these models, namely neoclassical and the Keynesian tradition.

On the one side, neoclassical approach predicts a positive multiplier for GDP as well as a crowding-out effect on private consumption. Indeed, underlying assumptions of neoclassical models highlight a negative wealth effect after the rise in government spending. Governments, through increase in public expenditure, reduce the available resources for private sector while give the signal to households of future rise in taxes. As such, economic agents reduce their consumption and increase their work hour, and therefore increase the output. According to neoclassical economists, the positive spending multiplier on GDP acts through supply side channels (Ramey, 2019). Baxter and King (1993), one of the leading papers in the neoclassical approach, analyze public spending multipliers using a standard DSGE model. They find a negative impact of fiscal policy, with size of 2.5, if public spending

is financed by distortionary taxes and if the rise in government expenditure is temporary. While deficit-financed government spending leads to multipliers below 1, the steady rise in public spending financed by lump-sum taxes induces large multipliers. In the latter case, the impact of change in spending is below unity in the short-run and around 1.2 in the long-run. On the other side, the magnitude of the fiscal multiplier from Keynesian approach is closely related to the marginal propensity of consumption. Indeed, the basic multiplier for government spending is equivalent to $1/(1-mpc)$ while $-mpc/(1-mpc)$ for taxes whether we keep interest rate unchanged. The size and the magnitude of the multiplier depends on several characteristics (Ramey, 2019). Galí et al. (2007), based on their assumptions on rule of thumb consumers and demand-determined employment, represents the mainstream finding in the Keynesian approach. They find a positive and high multiplier of government spending of about 2.0.

However, several points highlight some discrepancies between the two neoclassical and Keynesian tradition and the observed data. First, the standard Keynesian tradition does not account for rational expectations that is an important feature of household optimization program. Second, most of the neoclassical models assume the idea of the Ricardian equivalence, that is not really true in the real world (Diamond, 1965; Seater, 1993). To reconcile these two approaches, researchers developed the new Keynesian DSGE that incorporates some features of neoclassical models such as labor and price rigidities as well as rational expectations both for firms and households. Mostly used in the monetary policy analysis, the New Keynesian DSGE becomes increasingly implemented in fiscal policy analysis since Cogan et al. (2010). These authors rely on the famous Smets and Wouters (2003, 2007) model to assess the effects of American Recovery and Reinvestment Act (ARRA) 2009 on the US economy. According to Woodford (2009), Smets and Wouter model represents one of the prominent macroeconomics frameworks to analyze policy. It gives one of the best representations of the current thinking in macroeconomics.

In this paper, we rely on and expand the model of Smets and Wouters (2003, 2007) to assess the government spending multipliers of African economies, with an application on South

Africa. Our paper contributes to the literature in several points. First, despite the increasing adoption of DSGE model for macroeconomic policy analysis in both the developed and emerging economies, there have been very few papers focusing on fiscal policy forecasting exercise. Indeed, Olofin et al. (2014) is one of the first papers that develop a pragmatic DSGE model to assist in the process of providing evidence-based monetary policy decisions for the Central Bank of Nigeria. The study proposed and analysed the effects of three policy options or scenarios which are built around the assumptions of the changes that the Central Bank is likely to make to the Monetary Policy Rate. Gupta et al. (2015) estimate a DSGE model to forecast inflation in South Africa. They found that the DSGE performs extremely well in forecasting inflation variables in comparison with forecasts reported by other models such as AR models. However, these papers are focused on the performance between VAR and DSGE rather than on the analysis of fiscal multipliers. Second, we introduce several features to model to fit the characteristics of African economies. Indeed, we develop a small open economy following Medina et al. (2005) and Dib (2008) and integrate the commodity sector. This sector is a structural characteristic of economy in Africa. Second, we assume that the depreciation rate of capital stock as an increasing and convex function Following Schmitt-Grohé and Uribe (2012). Third, we assume that the interest rate on external debt include a risk premium following Adolfson et al. (2007), with the risk premium as an increasing function of the foreign assets to output.

Our findings suggest that 10 % increase in government purchases lead to a positive reaction of GDP up to 2 percentage points immediately affect the shock. This positive response lasts until 8 quarters after the shock. In other words, 1 % increase in government purchases lead to an increase in GDP by 0.2 %. These results are in line with the literature on New keynesian DSGE models. Indeed, Cogan et al. (2010) find small spending multipliers for the American Recovery and Reinvestment Act (ARRA). Regarding consumption and private investment, a change in public spending induce a reduction of both components. However, a demand stimulus policy leads to a short-run inflation followed by a rapid stabilization.

The rest of the paper is organized as follows. In Section 5.2, we present the details of the

model. Section 5.3 discusses estimation issues, including the Bayesian estimation strategy, the data used, parameter calibration and estimates, and the forecast performance of the model. Finally, Section 5.4 concludes.

5.2 Model outline

We consider a small open economy closely related to the one developed in Medina et al. (2005) and Dib (2008). There is a continuum of households, a continuum of domestic goods producing firms, a continuum of intermediate-goods importers, a government, and a central bank. We assume that there is an exogenous commodity good with is exogenously produced. Households are monopolistically competitive in the labour market and there is monopolistic competition in intermediate goods markets. Households consumption and investment are baskets of domestic and imported good. Following Christiano et al. (2005), the model include a number of nominal and real rigidities. In particular, wages and prices are sticky à la Calvo (1983); it is costly to adjust capital; and the depreciation rate of capital is increasing with the capital utilization rate. The model allows habit formation in consumption preferences and an interest rate risk premium. The model also incorporates different orthogonal structural shocks, including productivity shock, preference shock, investment technology shock, monetary policy shock, risk premium shocks, commodity price shock, and shocks to foreign variables. In the remaining part of the paper, the indexes of variables in commodity sector, domestic sector, and import sector are denoted by x, d and m, respectively.

5.2.1 Households

We consider an economy with an infinitely lived and identical households, indexed by $h \in (0, 1)$. A typical household h derives utility from consumption and leisure. The households preferences are subject to habit formation. For reasons of computational simplicity, the instantaneous utility function, $U_t(\cdot)$, is additively separable in consumption and leisure. The

lifetime utility of a typical household h is given by:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t U_t(h) = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \zeta_{U,t} \left[\frac{\left(C_t(h) - \hbar C_{t-1}\right)^{1-\sigma}}{1-\sigma} - A_L \frac{L_t(h)^{1+\eta}}{1+\eta} \right] \tag{5.1}$$

where $\mathbb{E}_t$ denotes the mathematical expectation operator conditional on information available at time t, $C_t(h)$ and $L_t(h)$ denote the h-th household's levels of aggregate consumption and labor supply, respectively. The parameter $\beta \in (0,1)$ is a constant discount factor. The parameters σ and η represent the inverse of the elasticity of intertemporal substitution of consumption and the inverse of the Frisch elasticity of labor supply. $\hbar \in (0,1)$ is the degree of internal habit formation, such that the household's marginal utility of consumption today is affected by the level of aggregate consumption in the last period, C_{t-1}. $\zeta_{U,t}$ is a persistent preference shock. A_L is a scale parameter governing the level of labor supply in the steady state.

Households are assumed to own physical capital and have access to riskless discount one-period domestic and foreign bonds. Each household enters period t with a quantity of nominal domestic bonds, $B_{t-1}(h)$, and a quantity of nominal foreign bonds, $B^{\star}_{t-1}(h)$, denominated in foreign currency, and capital stocks $K_{t-1}(h)$. In each period, the household h supplies labour and capital to firms in the production sectors and then receives labor income $W_t(h)L_t(h)$ and capital income $R_{K,t}K_{t-1}(h)$, where $W_t(h)$ is the nominal wage rate received by supplying labor and $R_{K,t}$ the rental price of capital. The household h also receives a dividend payments, of a total amount $Div_t(h)$, from producers. The household h uses these resources to finance it consumption, investment in new capital $I_t(h)$, and the acquisition of domestic and foreign assets to be carried over to the next period. Finally the household h pays a lump-sum tax $TX_t(h)$ to government. The flow budget constraint for the household h is given by:

$$\begin{aligned} P_t C_t(h) + P_{i,t} I_t(h) + B_t(h) + e_t B^{\star}_t(h) = R_{t-1} B_{t-1}(h) + e_t R_{bf,t-1} B^{\star}_{t-1}(h) \\ + W_t(h) L_t(h) + R_{K,t} u_t(h) K_{t-1}(h) + Div_t(h) - TX_t(h) \end{aligned} \tag{5.2}$$

where P_t and $P_{i,t}$ are the price index of consumption and investment, e_t is the nominal exchange rate, defined as the price of one unit of foreign currency in domestic currency, and R_t and $R_t^\star$ are the gross interest rate paid on the holding of domestic and foreign bond, respectively. We assume that households can control the capital utilisation rate, u_t. Formally, the effective amount of capital services supplied to firms in period t is given by $u_t(h)K_{t-1}(h)$. We assume that the capital stock evolves over time according to the law of motion

$$K_t(h) = (1 - \delta(u_t(h)))K_{t-1}(h) + \left(1 - S\left(\frac{I_t(h)}{I_{t-1}(h)}\right)\right)\zeta_{I,t}I_t(h) \tag{5.3}$$

Following Schmitt-Grohé and Uribe (2012), we assume that the depreciation rate of capital stock, given by $\delta(u)$, is an increasing and convex function of the capital utilisation rate: $\delta'(\cdot) > 0$ and $\delta''(\cdot) > 0$. Specifically, we adopt a quadratic form for the function $\delta(\cdot)$

$$\delta(u) = \delta_0 + \delta_1(u-1) + \frac{\delta_2}{2}(u-1)^2 \tag{5.4}$$

with $\delta_0, \delta_1, \delta_2 > 0$. The parameter δ_2 captures the sensitivity of capacity utilization to variations in the rental rate of capital. The closer δ_2 is to zero, the less sensitive there is and the easier it is to change utilization. The parameter δ_1 governs the steady-state level of u_t. We set this parameter at a value consistent with a unit steady-state value of u_t. And the parameter δ_0 corresponds to the rate of depreciation of the capital stock in steady state in which u_t is unity. The function $S(\cdot)$ is defined by $S(x) = \frac{\kappa}{2}(x-1)^2$ with $S(1) = S'(1) = 0$ and $S''(1) = \kappa > 0$. This functional form implies that it is costly to change the level of investment, the cost is increasing in the change in investment, and there are no adjustment costs in steady state. The variable $\zeta_{I,t}$ is an investment technology shock, or the marginal efficiency of investment. It captures the rate of transformation of investment into installed capital to be used in the production.

We assume that the interest rate $R_{bf,t}$ on external debt include a risk premium and is given by:

$$R_{bf,t} = \Phi(a_{bf,t}, \tilde{\phi}_t)R_t^\star \tag{5.5}$$

where the term $\Phi(a_{bf,t}, \tilde{\phi}_t)$ is a premium over the foreign interest rate, $R_t^\star$, that households have to pay when they borrow from abroad. The risk premium is increasing in the ratio of the aggregate real holdings of the foreign assets to output, as in Adolfson et al. (2007):

$$\Phi(a_{bf,t}, \tilde{\phi}_t) = \exp\left(-\varrho(a_{bf,t} - a_{bf}) + \tilde{\phi}_t\right) \tag{5.6}$$

where $a_{bf,t} = e_t B_t^\star / P_t Y_t$ with $B_t^\star = \int_0^1 B_t^\star(h)dh$ the total level of indebtedness of private sector abroad, $P_t Y_t$ the nominal output. a_{bf} is the long-run external debt-to-GDP ratio of private sector and $\varrho > 0$ is a parameter that determines the debt-elasticity of interest-rate premium. Variable $\tilde{\phi}_t$ is a shock to the risk premium.

The household's optimization problem consists in choosing a set of stochastic processes (allocation) $\{C_t, I_t(h), K_t(h), B_t(h), B_t^\star(h), u_t(h)\}_{t=0}^\infty$ to maximize its lifetime utility subject to its budget constraints and the law of motion for capital, taking as given the stochastic processes, and the initial conditions $C_{-1}(h)$, $B_{-1}(h)$, $B_{-1}^\star(h)$, and K_{-1}.

Following Christiano et al. (2005), we assume that each household h is a monopolistic supplier of a differentiated labor service. A competitive labor service assembler transforms these different labor services into aggregate labor with and associated aggregate wage index given by the Constant Elasticity of Substitution (CES) aggregator:

$$L_t = \left(\int_0^1 (L_t(h))^{\frac{\theta_w - 1}{\theta_w}} dh\right)^{\frac{\theta_w}{\theta_w - 1}} \quad \text{and} \quad W_t = \left(\int_0^1 (W_t(h))^{1-\theta_w} dh\right)^{\frac{1}{1-\theta_w}}$$

where $\theta_w > 1$ is the elasticity of substitution among different types of labor and L_t is the aggregate labor demand. In the literature $\frac{\theta_w}{\theta_w - 1}$ represents the markup of wages over the marginal rate of substitution of households. The demand for each differentiated labor service is given by:

$$L_t(h) = \left(\frac{W_t(h)}{W_t}\right)^{-\theta_w} L_t \tag{5.7}$$

In any given period, a fraction $(1 - \phi_w)$ of households are able to reset their wages. The remaining fraction ϕ_w of households can only partially index their wages to lagged inflation

rate and to inflation target set by the Central Bank. The indexation rule implies that the wage of household h who cannot re-optimize his wage between periods t and $t+\tau$ is given by $W_{t+\tau/t}(h) = \left(\prod_{s=1}^{\tau} \Pi_{t+s-1}^{\xi_w} \bar{\Pi}^{1-\xi_w}\right) W_t(h)$ where $\xi_w \in [0,1]$ measures the degree of indexation to the lagged inflation rate. The relevant part of the problem of households resetting their wages is given by:

$$\begin{aligned} &\max_{w_t(h)} \mathbb{E}_t \sum_{\tau=0}^{\infty} (\phi_w \beta)^{\tau} \left\{ U(C_{t+\tau}(h), L_{t+\tau/t}(h)) + \lambda_{t+\tau} w_{t+\tau/t}(h) L_{t+\tau/t}(h) \right\} \\ &s.t. : L_{t+\tau/t}(h) = \left(\frac{w_{t+\tau/t}(h)}{w_{t+\tau}} \right)^{-\theta_w} L_{t+\tau} \text{ and } w_{t+\tau/t}(h) = \left(\prod_{s=1}^{\tau} \frac{\Pi_{t+s-1}^{\xi_w} \bar{\Pi}^{1-\xi_w}}{\Pi_{t+s}} \right) w_t(h) \end{aligned} \tag{5.8}$$

where $w_{t+\tau}(h)/P_t$ and $w_{t+\tau/t}(h)/P_t$ are real wages.

5.2.2 Commodity goods

For simplicity, we abstract from the production decision in commodity sector by assuming that the economy is endowed with an exogenous commodity exports revenues, $P_{x,t}^{\star} Y_x^{\star}$, denominated in foreign currency. [2] We further assume that the state-owned company accounts for a share χ of commodity production, which accrues to the government as revenue.

5.2.3 Domestic goods

There is a continuum of monopolistically competitive firms $z \in (0,1)$. Each firm produces one intermediate good $Y_{d,t}(z)$ using capital, $K_{t-1}(z)$, and labour $L_t(z)$ and using a Cobb-Douglas production function:

$$Y_{d,t}(z) = A_{d,t} \, \tilde{K}_t(z)^{\alpha} \, L_t(z)^{1-\alpha} \tag{5.9}$$

[2] The model has been designed to explain the macroeconomic effects of increases in commodity prices driven by exogenous shocks that originate from abroad. It is not meant to explain the implication of the commodity production process.

where $\tilde{K}_t = u_t K_{t-1}$ is the effective utilization of the capital stock, i.e. the capital services. $A_{d,t}$ is a stationary technology shock capturing the productivity in the economy. The first order conditions from the real cost minimization yields the demand functions for inputs.

The real marginal cost of production (the lagrangian from the cost minimisation), $mc_{d,t}$, can be expressed as a function of the rental price of capital, the real wage, and the level of technology:

$$mc_{d,t} = \frac{1}{A_{d,t}} \left(\frac{r_{K,t}}{\alpha} \right)^{\alpha} \left(\frac{w_t}{1-\alpha} \right)^{1-\alpha} \tag{5.10}$$

Intermediate domestic goods are aggregated according to the Dixit-Stiglitz aggregator.

$$Y_{d,t} = \left(\int_0^1 \left(Y_{d,t}(z) \right)^{\frac{\theta_d - 1}{\theta_d}} dz \right)^{\frac{\theta_d}{\theta_d - 1}} \tag{5.11}$$

where θ_d is the elasticity of substitution between the tradable intermediate goods. It measures the degree of monopoly power of intermediate good producers. The case of perfect composition is nested when $\theta_d \to \infty$, since $\theta_d/(\theta_d - 1)$ represents the markup of price over marginal cost for producers in the tradable sector.

The domestic good can be use to produce the final good or can be exported abroad. We assume that the foreign demand for the domestic goods, $Y^x_{d,t}$, is exogenously given as:

$$Y^{\star}_{d,t} = \omega^{\star}_d \left(\frac{P_{d,t}}{e_t P^{\star}_t} \right)^{\gamma^{\star}_d} Y^{\star}_t \tag{5.12}$$

where $Y^{\star}_t$ and $P^{\star}_t$ are foreign output and foreign price index respectively, $\gamma^{\star}_d$ represents the elasticity of demand for domestic goods by foreigners, while $\omega^{\star}_d$ is a scale parameter. Its is assumed that the foreign demand is exogenous. In the above specification of the foreign demand for domestic goods, we implicitly assume that the law of one price holds for domestic.

In each period, a fraction $(1 - \phi_d)$ of domestic intermediate goods producers reset their prices, while the remaining fraction ϕ_d of firms who cannot reset their price, partially index their nominal price to lagged inflation of price index of domestic good and to inflation target set by the Central Bank. The indexation rule implies that the price of a domestic

good for firm z who cannot change its price between periods t and $t+\tau$ is $P_{d,t+\tau/t}(z) = \left(\prod_{j=1}^{\tau} \Pi_{d,t+j-1}^{\xi_d} \bar{\Pi}^{1-\xi_d}\right) P_{d,t}(z)$ where $\Pi_{d,t} = P_{d,t}/P_{d,t-1}$ is the gross inflation rate of price of domestic good and $\xi_d \in [0,1]$ captures the degree of indexation. At each time t, a typical producer z of domestic good choose the real price $p_{d,t}(z) = P_{d,t}/P_t$ that maximizes the present value of its future real profits:

$$\begin{aligned} &\max_{p_{d,t}(z)} \mathbb{E}_t \sum_{\tau=0}^{\infty} (\phi_d \beta)^{\tau} \left(\frac{\lambda_{t+\tau}}{\lambda_t}\right) \left\{p_{d,t+\tau/t}(z) - mc_{d,t+\tau}\right\} Y_{d,t+\tau/t}(z) \\ &s.t.: Y_{d,t+\tau/t}(z) = \left(\frac{p_{d,t+\tau/t}(z)}{p_{d,t+\tau}}\right)^{-\theta_d} Y_{d,t+\tau} \text{ and } p_{d,t+\tau/t}(z) = \left(\prod_{j=1}^{\tau} \frac{\Pi_{d,t+j-1}^{\xi_d} \bar{\Pi}^{1-\xi_d}}{\Pi_{t+j}}\right) p_{d,t}(z) \end{aligned} \tag{5.13}$$

Given the same marginal cost of production, all firms that reset their prices at time t choose the same optimal price, $\tilde{p}_{d,t}(z) = \tilde{p}_{d,t}$.

5.2.4 Imported goods

There is a continuum $z \in (0,1)$ of monopolistic importers that purchase an homogeneous good in the foreign market at price $e_t P_t^{\star}$. Each importing firm z converts its good to a differentiated imported good, $Y_{m,t}(z)$, and sells at price $P_{m,t}(z)$ in the domestic market to a competitive assembler to produce an imported composite good. We also assume a Calvo pricing for the imported goods. Let denote by θ_m the elasticity of substitution between the imported differentiated goods, ϕ_m the fraction of importers who cannot reset their price, and ξ_m the degree of import price indexation. The price setting problems of the importing firms are analogous to those of the domestic firms.

5.2.5 Final goods: consumption and investment

We assume that the households' final consumption (C_t) and the investment (I_t) are baskets of goods produced by perfectly competitive distributors using domestic and imported goods

as inputs and according to a constant elasticity of substitution (CES) production function. The households' consumption basket is

$$C_t = \left((1-\omega_{mc})^{\frac{1}{\gamma_c}}(C_{d,t})^{\frac{\gamma_c-1}{\gamma_c}} + \omega_{mc}^{\frac{1}{\gamma_c}}(C_{m,t})^{\frac{\gamma_c-1}{\gamma_c}}\right)^{\frac{\gamma_c}{\gamma_c-1}} \tag{5.14}$$

where $C_{d,t}$ and $C_{m,t}$ are the domestic and imported goods consumed by households. Parameter γ_c is the elasticity of substitution between domestic and imported goods in consumption and ω_{mc} defines the weight of imported good in consumption. Given the price of the consumption basket P_t, the demand functions for domestic and imported goods are determined by the real profit maximisation.

The production function for investment good isomorphic to that of consumption. We allowing for possible differences in the import intensity (ω_{mi}) and the elasticity of substitution between imports and domestic goods (γ_i). Finally, we assume that government consumption is composed of only domestic goods.

5.2.6 Monetary authority and Government

We assume that the Central Bank follows a Taylor-type interest rate rule:

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\rho_R}\left[\left(\frac{\Pi_t}{\Pi}\right)^{r_\Pi}\left(\frac{Y_t}{Y}\right)^{r_Y}\left(\frac{\Delta e_t}{\Delta e}\right)^{r_{\Delta e}}\right]^{1-\rho_R}\exp(\varepsilon_{R,t}) \tag{5.15}$$

where R, Π, Y, and Δe are the steady-state values of R_t, Π_t, Y_t, and Δe_t. ρ_R is the interest rate smoothing parameter, while r_Π, r_Y, and $r_{\Delta Y}$ are the policy responses to contemporaneous deviation of inflation, output, and output growth from their steady-state values, respectively. The term $\varepsilon_{R,t}$ is an uncorrelated monetary policy shock, normally distributed with a mean of zero and variance σ_R. This shock corresponds to a deviation from the policy rule, which can be interpreted as the non-systematic component of monetary policy. When $r_{\Delta e} \to \infty$ and $r_\Pi = r_Y = 0$, the monetary authority strictly targets the nominal exchange rate, leading to a fixed exchange rate regime.

The government receives each period an amount $\chi rer_t \tilde{Y}_{x,t}$ from the revenues of commodity

exports. We assume that the government has access to lump-sum taxes and domestic debt. The government spends an exogenous amount G_t domestic goods. The government's budget constraint is

$$p_{d,t}G_t + \frac{R_{t-1}B_{t-1}}{P_t} = \frac{B_t}{P_t} + TX_t + \chi rer_t \tilde{Y}_{x,t} \tag{5.16}$$

Fiscal policy is defined by the three variables G_t, TX_t, and B_t. Given the budget constraint of the government, it is necessary to define a behavioral rule for two of the three policy variables in order to completely characterize the fiscal policy. We assume that the government expenditure is exogenously given by an AR(1) process. We also assumed a zero domestic bond, $B_t = 0$, for all $t > 0$. The lump-sum tax is then adjusted so as to satisfy the government budget constraint. Fiscal policy is neutral.

5.2.7 The foreign economy

Following, Adolfson et al. (2007), We assume that foreign output, foreign inflation, and foreign interest rate are exogenously given by an estimated identified VAR(1) model. Let denote by $X_t^\star = [\hat{Y}_t^\star, \hat{\Pi}_t^\star, \hat{R}_t^\star]'$ the log deviation of vector $[Y_t^\star, \Pi_t^\star, R_t^\star]'$ from the steady state. The foreign economy is modeled as a VAR model,

$$X_t^\star = A(L)X_{t-1}^\star + C\varepsilon_{x^\star,t} \tag{5.17}$$

where A(L) is a matrix lag operator, C is a lower triangular matrix. The ε_t's are structural orthogonal shocks assumed to be i.i.d., normal distributed with mean zero an unit variance. The structure of the matrix C assumes that contemporaneous shock to foreign output affects only output and interest rate in the same period while contemporaneous shock to foreign inflation only affects inflation rate and interest rate in the same period and contemporaneous shock to interest rate only affects interest rate in the same period. Implicitly, we assume that output and inflation are predetermined relative to the monetary policy shock.

5.2.8 Equilibrium

We consider a symmetric equilibrium where all households, intermediate goods-producing firms, and importers make identical decisions. Combining the household's budget constraint, government budget, and profit functions of producing firms yields the Balance of Payment equation that describes the dynamics of the foreign debt.

$$e_t B_t^\star = R_{bf,t-1} e_t B_{t-1}^\star + P_{d,t} Y_{d,t}^\star + e_t P_{x,t}^\star Y_{x,t}^\star - e_t P_t^\star Y_{m,t} \tag{5.18}$$

The real gross domestic product (GDP), Y_t, measured in terms of consumption good, is defined as:

$$Y_t = C_t + p_{i,t} I_t + p_{d,t} G_t + p_{d,t} Y_{d,t}^\star + rer_t p_{x,t}^\star Y_{x,t}^\star - rer_t Y_{m,t} \tag{5.19}$$

5.3 Estimation and Forecasting

The model is estimated on South Africa economy. The estimations are conducted using a Bayesian approach. The full log-linearized equations of the model can be found in the appendix.

Data

The estimation uses ten quarterly series for the period 2000:1 to 2016:4. The starting date corresponds to the beginning of the period of the inflation-targeting regime of the South African Reserve Bank. The series includes real GDP, real private consumption, investment, government consumption, nominal interest rate, inflation rate, and nominal exchange rate. The remaining data include foreign output, foreign inflation rate and foreign interest rate. Real GDP and real private consumption are expressed in per capita terms by dividing them by the working age population. Private consumption is measured by household final consumption expenditure. Investment is measured by private business enterprises gross fixed capital formation plus general governments gross fixed capital formation. Government consumption is measured by general government final consumption expenditures. The inflation

rates is measured by the changes in GDP deflator. The nominal interest rate is measured by the rate three-month rates Treasury Securities for South Africa. Foreign output is measured by the Group Seven GDP volume index and the associated deflator is used to compute the foreign inflation. Finally, the foreign interest rate is measured by the three-month London Interbank Offered Rate (LIBOR), based on U.S. Dollar. The real exchange rate is the nominal exchange rate multiplied by the ratio of foreign GDP deflator to South Africa's GDP deflator. The nominal exchange rate is measured by the price of one U.S. dollar in terms of South African Rand. The data for South Africa are taken from South African Reserve Bank. The data for the Group Seven are taken from the Organisation for Economic Co-operation and Development (OECD) and data on LIBOR are taken from the Federal Reserve Economic Data (FRED). GDP, private consumption, investment and government consumption are prior expressed in per capita terms using the working age population (15-64). These data are extracted from the Federal Reserve Economic Data (FRED). The original series for population contain missing values. We use linear interpolation to replace the missing values.

Observed variables in the data, that will be link to the stationary variables of the model, include the quarter-over-quarter (QoQ) log difference of real GDP, real consumption, real investment, real government consumption, real exchange rate and foreign output and the log of the interest rates and inflation rates. All the series are demeaned in order to be consistent with the zero mean of the theoretical linearized model around its deterministic steady state. It should be noted that the estimation requires that the number of shocks must be greater or equal to the number of observed variables.

Calibration, priors and posteriors

We calibrate the model to reflect the fundamental of the South African economy. The share of steady state government spending is assumed to be 19.5 percent. Foreign assets to GDP is set at -30.9 percent at the steady state. The steady state ratio of natural resource rents to GDP is set equal 6.1 percent. These ratios corresponds more or less to their average share in the data over the estimation period. We also choose to fix parameters with standard

values in the literature and those we think are weakly identified by the dataset used for the estimation. We set $\beta = 0.995$, which implies a steady-state annualized real interest rate of 2 percent. We set $\delta = 0.025$, which implies an annual depreciation rate of capital of 10 percent. We set Π and $\Pi^{\star}$ so that to have an annual inflation rate of 7.7 percent for the South African economy and 2.1 percent for the foreign economy. The price markup over marginal cost of domestic and imported goods are set equal to 1.10. The parameter θ_w is also set equal to 11, which implies a wage markup of 1.10. The real prices of goods p_d, p_m, and p_i are normalized to unity at the steady state. The steady state exogenous variable level are normalized to unity. The steady state of labor supply is set at one-third of the household's available time.

The remaining parameters, that are crucial to the model's dynamics, are estimated using Bayesian methods. In the estimation, to avoid identification issue, we constrain the elasticity of substitution between domestic and imported goods to be identical in the consumption and investment baskets, $\gamma_c = \gamma_i$. Table 5.3 and 5.4 show the assumptions for the prior distribution of the estimated parameters. The choice of the appropriate prior information is tricky, because it requires finding the appropriate domain of prior information for each parameter, as well as the shape of the prior distribution.[3] In general, we assume an inverse-gamma distribution for parameters bounded to be positive, a gamma distribution for parameters bounded to be non-negative, and a beta distribution for parameters bounded between 0 and 1.

The estimations are conducted using the *Dynare* toolbox for *Matlab* developed by Adjemian et al. (2011). We first estimate the external foreign economy block outside the main model. Table 5.3 and 5.4 also display the posterior means and standard deviations, as well as the 90% highest posterior density interval from posterior simulation for the estimated parameters.

Using the information in the data results in a substantial shift in the posteriors relative to the priors for most of the estimated parameters. The posterior mean of the intertemporal

[3]The strategy to choose appropriate values for prior information is to start with given values in the prior domains and adjust these according to whether the optimizer indicates upper-bound constraints or lower-bound constraints for the particular parameter.

elasticity of consumption is equal to $\sigma = 3.2$, which is higher than the standard calibrated value of 1 in the literature. The posterior mean of the labor supply elasticity, η, is estimated to be 2.35, which is very close to its prior mean. The posterior mean for the elasticity of substitution between domestic goods and imported goods is estimated to be 0.33. The degree of habit formation in consumption, $\hbar$, is estimated at 0.24, very lower than it prior mean. The estimates of investment-adjustment cost parameter, κ, is equal to 30, which is very higher than it prior mean. This value implies that a 1 percent change in the price of capital induces $1/\kappa = 0.034$ percent change in investment. The elasticity of capital utilization with respect to the rental rate of capital is $(\delta_2/\delta_1)^{-1} = 2.61$.

Turning to the parameters for nominal rigidities and for monetary policy rules, the posterior means for the degree of price stickiness for domestic goods and imported goods imply expected price durations of about $1/(1-\phi_d) = 1.6$ quarters and 17.8 quarters. The degree of wage stickiness implies that nominal wages remain unchanged, on average, for about 3.4 quarters. The estimated value of the interest rate smoothing coefficients is $\rho_R = 0.93$. The estimates of r_Π, which measure the response of monetary policy to inflation is 1.3. The estimates of the posterior means ϱ_Y and $\varrho_{\Delta e}$, which measure the response to output movements and exchange rate depreciation are 0.01 and 0.1 very close to their prior means. The monetary policy rule estimates imply strong responses to inflation by monetary authorities.

Finally, the estimated values for persistence parameters of exogenous shocks except investment shock, ranging between 0.63 and 0.94, are moderately persistent. In contrast, investment shock is more volatile than the other shocks, which is consistent with the economic literature.

Impulse responses and fiscal multipliers

We outline in this section the responses of some variables to a positive shock on government spending. While the black solid lines show the mean impulse responses of variables, the dark gray dotted lines represent the corresponding 90% highest posterior density intervals.
Simulating a 10 % increase in public spending, figure 5.1 shows a positive reaction of GDP

up to 2 percentage points immediately affect the shock. This positive response lasts until 8 quarters after the shock. In other words, 1 % increase in government purchases lead to an increase in GDP by 0.2 %. These results are in line with the literature on New keynesian DSGE models. Indeed, Cogan et al (2010) find small spending multipliers for the American Recovery and Reinvestment Act (ARRA). Smets and Wouter (2003, 2007) predicts a quite similar effects for demand shocks.

Regarding the private investment, results seems to support the crowding-out effect of public spending. Indeed, our positive shock induce a negative response of private over the whole period. This result holds also for private consumption.

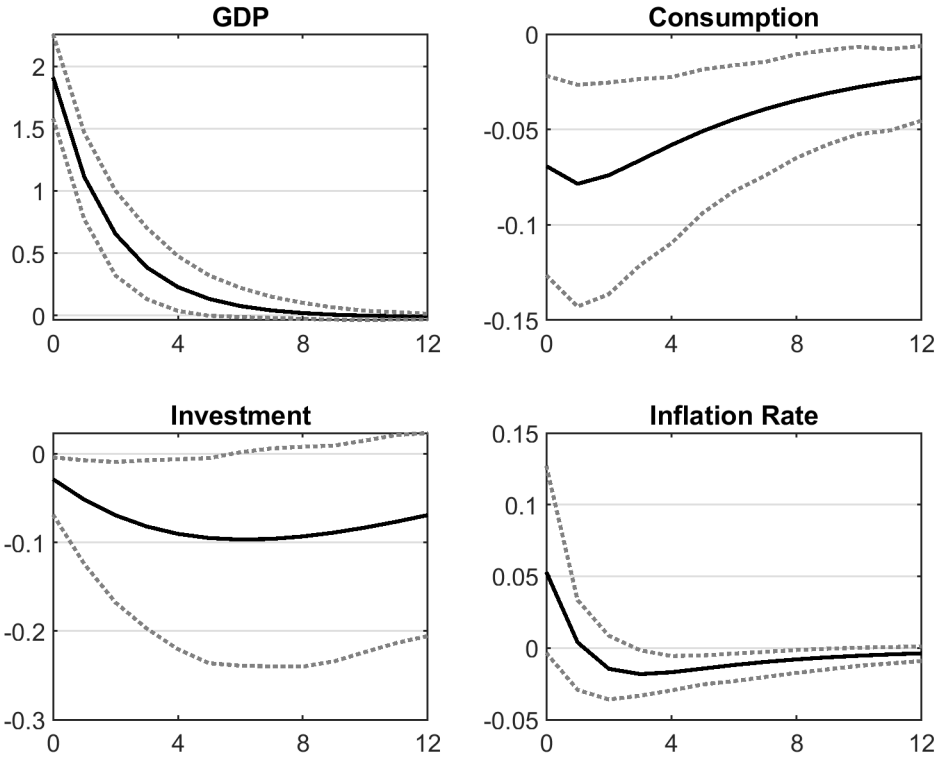
Regarding the inflation rate, the shock on government spending lead to a rise inflation at the time of the shock following by a decrease in the price level as of the first quarter.

Forecast performance

In this section, we compare the out-of-sample forecast performance of the estimated DSGE model with that of classical VAR(2)[4] model estimated on the same dataset. We initially estimate the two models over the period 2000:1 to 2016:4. Following Smets and Wouters (2007), we generate recursive out-of-sample forecast for different horizons over the period 2017:1 to 2018:4. The models are re-estimated each quarter over the period 2016:4 to 2018:3 in order to update the estimate of the coefficients, before producing the forecasts. Table 5.1 reports out-of sample Root Mean Squared Errors (RMSEs) for selected observed variables for different forecast horizons over the period 2017:1 to 2018:4. The DSGE model is found to considerably outperform the classical VAR in the short run, up to four-quarters-ahead for most of variables of interest. This results is consistent with Smets and Wouters (2007) who find that the DSGE model does considerably better than the VAR model up to three years in the case of the United States.

[4]The lag length of the classical VAR has been choosen base on information criteria.

Figure 5.1 – Impulse Response on GDP



Note: Figures represent the responses of a shock of 10 % increase in government spending on GDP, inflation as well as private consumption and investment.

Table 5.1 – Comparison of the RMSEs of out-of-sample forecasts – South Africa

	GDP	CONS	INV	GCONS	INFL	INTR	EXR
1q	1.22	2.06	3.84	2.16	1.58	0.11	9.35
2q	1.18	1.32	3.25	0.61	1.36	0.17	6.97
3q	1.19	1.63	3.41	1.02	1.45	0.21	7.70
4q	1.12	1.30	3.61	0.58	1.51	0.10	8.17
8q	0.01	0.38	0.29	0.86	0.51	0.15	0.24
DSGE		Percentage gains (+) or losses (-) relative to VAR(2) model					
1q	-18.7	24.0	10.3	64.5	6.9	53.7	27.5
2q	11.0	4.6	3.7	26.8	-3.4	76.5	0.4
3q	6.6	19.1	9.5	55.0	-4.2	68.0	2.6
4q	-6.0	-11.1	10.6	10.3	-7.6	40.1	0.6
8q	-49.6	-43.5	86.8	26.7	-47.9	49.5	-71.6

5.4 Conclusion

We developed a DSGE model for African economies, characterised by an incomplete pass-through of exchange rate and a number of nominal and real rigidities. Starting from the Smets and Wouter (2003) model, we expand the model to an small open economy. In addition, we introduce the commodity sector that is an important feature of African economy. After that, we introduce nominal and wage rigidities following Calvo (1983). We use this model to investigate and quantify the government spending multipliers in Africa. The model is estimated on South Africa using quarterly data. We find positive and small government spending multiplier on GDP. 10 % increase in public spending lead to only 2 % change in GDP. This result is globally in line the literature (Cogan et al., 2010; Smets and Wouters, 2003, 2007). The model is also used to conduct out-of-sample forecast exercises for the main macroeconomic variables. Overall, the DSGE model is found to perform better than the classical VAR model for most of the one- to four-quarters-ahead forecasts (over one year). Based on the out-of-sample forecasting exercise, there is quite strong evidence that the DSGE model is relatively suited model in forecasting the main macroeconomic variables in the short run, up to four-quarters-ahead.

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5.5 Appendix

5.6 Tables: Calibration, Priors and Posteriors

Table 5.2 – Calibrated Parameters and Steady-State Ratios – South Africa

Description	Parameter	value	Description	Parameter	value
β	Discount factor	0.995	Π	Steady state inflation	1.019
δ_0	Depreciation rate	0.024	$\Pi^\star$	Steady state foreign inflation	1.005
θ_w	Elasticity of sub. labor supply	11	G/Y	Government consumption to GDP	0.195
θ_d	Elasticity of sub. traded goods	11	$rer.b^\star/Y$	Foreign assets to GDP	-0.309
θ_m	Elasticity of sub. imported goods	11	$rer.p_x^\star Y_x^\star/Y$	Commodity exports to GDP	0.061
L	Steady state labor supply	0.33			

The other parameters or ratios appearing in the linearized equations are implicitly related the above parameters. The real price of goods and the steady state level of exogenous processes are set to unity.

Table 5.3 – Prior and Posterior Distribution of Structural Parameters – South Africa

Parameter	Prior Shape	Prior Mean	Prior SD	Posterior Mean	LB of 90% Interval	UB of 90% Interval
σ_c	Inv. gamma	2	0.5	2.534	1.582	3.708
σ_l	Inv. gamma	2	0.5	2.037	1.173	3.201
$\gamma_c = \gamma_i$	Inv. gamma	0.5	0.25	0.331	0.192	0.527
ω_{mi}	Beta	0.5	0.15	0.599	0.419	0.769
γ_x	Inv. gamma	1	0.5	1.041	0.899	1.196
α	Beta	0.26	0.02	0.258	0.254	0.263
$\hbar$	Beta	0.5	0.2	0.176	0.025	0.358
κ	Inv. gamma	25	50	42.893	13.323	80.071
δ_2/δ_1	Inv. gamma	0.5	0.25	0.377	0.203	0.602
ϱ	Inv. gamma	0.01	1	0.011	0.002	0.024
ϕ_w	Beta	0.75	0.15	0.677	0.450	0.891
ϕ_d	Beta	0.75	0.15	0.178	0.046	0.336
ϕ_m	Beta	0.75	0.15	0.968	0.943	1.000
ξ_w	Beta	0.5	0.2	0.246	0.019	0.549
ξ_d	Beta	0.5	0.2	0.230	0.016	0.514
ξ_m	Beta	0.5	0.2	0.405	0.096	0.760
ρ_R	Beta	0.8	0.1	0.933	0.906	0.955
r_Π	Gamma	1.5	0.5	1.673	1.121	2.320
r_Y	Gamma	0.01	0.005	0.009	0.002	0.017
$r_{\Delta e}$	Gamma	0.1	0.05	0.101	0.031	0.186

Posteriors are obtained from 2 chains of 50,000 draws generated using a random walk Metropolis-Hasting algorithm, and we discard the initial 25,000. HPD stands for Highest Posterior Density interval.

Table 5.4 – Prior and Posterior Distribution of Shocks Processes – South Africa

Parameter	Prior Shape	Prior Mean	Prior SD	Posterior Mean	LB of 90% Interval	UB of 90% Interval
ρ_A	Beta	0.8	0.1	0.783	0.588	0.970
ρ_G	Beta	0.6	0.1	0.595	0.442	0.747
$\rho_{p_x^\star}$	Beta	0.8	0.1	0.813	0.670	0.936
ρ_{ζ_U}	Beta	0.6	0.1	0.607	0.473	0.740
ρ_{ζ_I}	Beta	0.8	0.1	0.930	0.879	0.977
$\rho_{\tilde{\phi}}$	Beta	0.8	0.1	0.754	0.615	0.890
σ_{A_d}	Inv. gamma	0.02	2	0.020	0.011	0.032
σ_G	Inv. gamma	0.02	2	0.020	0.017	0.024
$10 * \sigma_R$	Inv. gamma	0.01	2	0.016	0.013	0.019
σ_{ζ_U}	Inv. gamma	0.05	2	0.071	0.036	0.115
σ_{ζ_I}	Inv. gamma	0.2	2	0.367	0.117	0.705
$10 * \sigma_{\tilde{\phi}}$	Inv. gamma	0.05	2	0.067	0.035	0.104
$\sigma_{p_x^\star}$	Inv. gamma	0.1	2	0.133	0.108	0.161

Posteriors are obtained from 2 chains of 50,000 draws generated using a random walk Metropolis-Hasting algorithm, and we discard the initial 25,000. HPD stands for Highest Posterior Density interval.

5.7 The (Log-) linearized model

Variables with hats correspond to their (log or percentage)-deviation from their steady state level: $\hat{x}_t = (x_t - x)/x \approx \ln(x_t) - \ln(x)$, unless otherwise indicated. The equations of the model in level are in orange color while the implied linearized equations are in black. We use first order Taylor approximation around the deterministic steady state.

1. Euler equation for consumption:

$$\lambda_t = \zeta_{U,t} \left(C_t - \hbar C_{t-1}\right)^{-\sigma}$$

$$\lambda_t = \beta R_t \mathbb{E}_t \left[\frac{\lambda_{t+1}}{\Pi_{t+1}}\right]$$

$$\hat{C}_t = \frac{\hbar}{1+\hbar}\hat{C}_{t-1} + \frac{1}{1+\hbar}E_t\hat{C}_{t+1} - \frac{1-\hbar}{(1+\hbar)\sigma}(\hat{R}_t - E_t\hat{\pi}_{t+1}) + \frac{1-\hbar}{(1+\hbar)\sigma}(\hat{\zeta}_{U,t} - E_t\hat{\zeta}_{U,t+1}) \quad (5.1)$$

2. The investment equation

$$p_{i,t} = q_t\zeta_{I,t}\left[1 - S\left(\frac{I_t}{I_{t-1}}\right) - S'\left(\frac{I_t}{I_{t-1}}\right)\left(\frac{I_t}{I_{t-1}}\right)\right] + \beta\mathbb{E}_t\left[q_{t+1}\zeta_{I,t+1}\left(\frac{\lambda_{t+1}}{\lambda_t}\right)S'\left(\frac{I_{t+1}}{I_t}\right)\left(\frac{I_{t+1}}{I_t}\right)^2\right]$$

$$\hat{I}_t = \frac{1}{1+\beta}\hat{I}_{t-1} + \frac{\beta}{1+\beta}E_t\hat{I}_{t+1} + \frac{1}{\kappa(1+\beta)}(\hat{q}_t + \hat{\zeta}_{I,t}) - \frac{1}{\kappa(1+\beta)}\hat{p}_{i,t} \quad (5.2)$$

3. The shadow (real) price of capital (the Tobin's q)

$$q_t = \beta\mathbb{E}_t\left[\left(\frac{\lambda_{t+1}}{\lambda_t}\right)\left(u_{t+1}r_{K,t+1} + (1 - \delta(u_{t+1}))q_{t+1}\right)\right]$$

$$\hat{q}_t = (1 - \beta(1-\delta))\,E_t\hat{r}_{K,t+1} - (\hat{R}_t - E_t\hat{\pi}_{t+1}) + \beta(1-\delta)E_t\hat{q}_{t+1} + \hat{\varepsilon}_{q,t} \quad (5.3)$$

$\hat{\varepsilon}_{q,t}$, not directly modeled, is a shock to the rate of return on equity investment. This shock is meant to capture changes in the cost of capital that may be due to imperfect

information between the capital producing borrowers and the financial intermediaries Smets and Wouters (2003).

4. Equation of capital utilisation rate:

$$r_{K,t} = q_t \delta'(u_t)$$

$$\hat{r}_{K,t} = \hat{q}_t + \left(\frac{\delta''}{\delta'}\right)\hat{u}_t \tag{5.4}$$

5. The capital accumulation equation:

$$K_t = (1-\delta(u_t))K_{t-1} + \left(1 - S\left(\frac{I_t}{I_{t-1}}\right)\right)\zeta_{I,t} I_t$$

$$\hat{K}_t = (1-\delta)\hat{K}_{t-1} - \delta'\hat{u}_t + \delta(\hat{I}_t + \hat{\zeta}_{I,t}) \tag{5.5}$$

6. Uncovered interest parity condition:

$$\mathbb{E}_t\left\{\frac{\lambda_{t+1}}{\lambda_t}\frac{1}{\Pi_{t+1}}\left(R_t - \left(\frac{e_{t+1}}{e_t}\right)R_{bf,t}\right)\right\} = 0$$

$$R_{bf,t} = \Phi(a_{bf,t}, \tilde{\phi}_t)R_t^\star$$

$$\Phi(a_{bf,t}, \tilde{\phi}_t) = \exp\left(-\varrho(a_{bf,t} - a_{bf}) + \tilde{\phi}_t\right)$$

$$\hat{R}_t = \hat{R}_t^\star + \hat{\Phi}_t + E_t\Delta\hat{e}_{t+1} \Leftrightarrow (\hat{R}_t - E_t\hat{\pi}_{t+1}) = (\hat{R}_t^\star - E_t\hat{\pi}_{t+1}^\star) + \hat{\Phi}_t + E_t\Delta r\hat{e}r_{t+1} \tag{5.6}$$

$$\hat{R}_{bf,t} = \hat{R}_t^\star + \hat{\Phi}_t \tag{5.7}$$

$$\hat{\Phi}_t = -\varrho\left(\frac{rer.b^\star}{Y}\right)(r\hat{e}r_t + \hat{b}_t^\star - \hat{Y}_t) + \hat{\tilde{\phi}}_t \tag{5.8}$$

$$\hat{a}_{bf,t} = \left(\frac{rer.b^\star}{Y}\right)\left(r\hat{e}r_t + \hat{b}_t^\star - \hat{Y}_t\right) \quad \text{with} \quad \hat{a}_{bf,t} = a_{bf,t} - a_{bf} \tag{5.9}$$

Marginal rate of substitution between labor and consumption & wage setting

$$f_{w,t} = \zeta_{U,t} A_L \left(\frac{\tilde{w}_t}{w_t}\right)^{-\theta_w(1+\eta)} L_t^{1+\eta} + (\phi_w\beta)\mathbb{E}_t \left(\frac{\Pi_t^{\xi_w}\bar{\Pi}^{1-\xi_w}}{\Pi_{t+1}}\right)^{-\theta_w(1+\eta)} \left(\frac{\tilde{w}_t}{\tilde{w}_{t+1}}\right)^{-\theta_w(1+\eta)} f_{w,t+1}$$

$$f_{w,t} = \left(\frac{\theta_w - 1}{\theta_w}\right)\left(\frac{\tilde{w}_t}{w_t}\right)^{1-\theta_w} \lambda_t w_t L_t + (\phi_w\beta)\mathbb{E}_t \left(\frac{\Pi_t^{\xi_w}\bar{\Pi}^{1-\xi_w}}{\Pi_{t+1}}\right)^{1-\theta_w} \left(\frac{\tilde{w}_t}{\tilde{w}_{t+1}}\right)^{1-\theta_w} f_{w,t+1}$$

$$w_t^{1-\theta_w} = \phi_w \left(\frac{\Pi_{t-1}^{\xi_w}\bar{\Pi}^{1-\xi_w}}{\Pi_t} w_{t-1}\right)^{1-\theta_w} + (1-\phi_w)\tilde{w}_t^{1-\theta_w}$$

$$\begin{aligned}\hat{w}_t =& \frac{\beta}{1+\beta}E_t\hat{w}_{t+1} + \frac{1}{1+\beta}\hat{w}_{t-1} + \frac{\beta}{1+\beta}E_t\hat{\pi}_{t+1} - \frac{1+\xi_w\beta}{1+\beta}\hat{\pi}_t + \frac{\xi_w}{1+\beta}\hat{\pi}_{t-1} \\ & - \frac{1}{1+\beta}\frac{(1-\beta\phi_w)(1-\phi_w)}{(1+\theta_w\eta)\phi_w}\left[\hat{w}_t - m\hat{r}s_t - \hat{\varepsilon}_{w,t}\right]\end{aligned} \tag{5.10}$$

where $m\hat{r}s_t = \eta\hat{L}_t + \frac{\sigma}{1-\hbar}(\hat{C}_t - \hbar\hat{C}_{t-1})$. One can introduce a "cost-push" shock, $\varepsilon_{w,t}$, to the wage markup by assuming a time-varying markup in wages.

7. Production of domestic good:

$$Y_{d,t} = A_{d,t}\tilde{K}_t^{\alpha} L_t^{1-\alpha}$$

where $\tilde{K}_t = u_t K_{t-1}$.

$$\frac{w_t L_t}{r_{K,t}\tilde{K}_t} = \frac{1-\alpha}{\alpha}$$

$$mc_{d,t} = \frac{1}{A_{d,t}}\left(\frac{r_{K,t}}{\alpha}\right)^{\alpha}\left(\frac{w_t}{1-\alpha}\right)^{1-\alpha}$$

$$\hat{Y}_{d,t} = \hat{A}_{d,t} + \alpha(\hat{u}_t + \hat{K}_{t-1}) + (1-\alpha)\hat{L}_t \tag{5.11}$$

$$\hat{w}_t + \hat{L}_t = \hat{r}_{K,t} + \hat{u}_t + \hat{K}_{t-1} \tag{5.12}$$

$$m\hat{c}_{d,t} = -\hat{A}_{d,t} + \alpha\hat{r}_{K,t} + (1-\alpha)\hat{w}_t \tag{5.13}$$

8. Price setting for domestic good: Phillips curve

$$f_{d,t} = \tilde{\Pi}_{d,t}\lambda_t p_{d,t} Y_{d,t} + (\phi_d\beta)\mathbb{E}_t\left\{\left(\frac{\Pi_{d,t}^{\xi_d}\bar{\Pi}^{1-\xi_d}}{\Pi_{t+1}}\right)^{1-\theta_d}\left(\frac{\tilde{\Pi}_{d,t}}{\tilde{\Pi}_{d,t+1}}\right) f_{d,t+1}\right\}$$

$$f_{d,t} = \left(\frac{\theta_d}{\theta_d - 1}\right)\lambda_t mc_{d,t} Y_{d,t} + (\phi_d\beta)\mathbb{E}_t\left\{\left(\frac{\Pi_{d,t}^{\xi_d}\bar{\Pi}^{1-\xi_d}}{\Pi_{t+1}}\right)^{-\theta_d} f_{d,t+1}\right\}$$

$$1 = \phi_d\left(\frac{\Pi_{d,t-1}^{\xi_d}\bar{\Pi}^{1-\xi_d}}{\Pi_{d,t}}\right)^{1-\theta_d} + (1-\phi_d)\tilde{\Pi}_{d,t}^{1-\theta_d}$$

$$\hat{\pi}_{d,t} = \frac{\beta}{1+\beta\xi_d}\hat{\pi}_{d,t+1} + \frac{\xi_d}{1+\beta\xi_d}\hat{\pi}_{d,t-1} + \frac{1}{1+\beta\xi_d}\frac{(1-\phi_d)(1-\beta\phi_d)}{\phi_d}(\hat{mc}_{d,t} + \hat{\varepsilon}_{d,t}) \quad (5.14)$$

One can introduce a "cost-push" shock, $\varepsilon_{d,t}$, to the inflation equation (also call shock to price markup) by assuming a time-varying markup in the goods market.

9. Exports of domestic good:

$$Y_{d,t}^{\star} = \omega_d^{\star}\left(\frac{p_{d,t}}{rer_t}\right)^{-\gamma_d^{\star}} Y_t^{\star}$$

$$\hat{Y}_{d,t}^{\star} = \hat{Y}_t^{\star} - \gamma_d^{\star}(\hat{p}_{d,t} - \hat{rer}_t) \quad (5.15)$$

10. Price setting for imported good: Phillips curve

$$f_{m,t} = \tilde{\Pi}_{m,t}\lambda_t p_{m,t} Y_{m,t} + (\phi_m\beta)\mathbb{E}_t\left\{\left(\frac{\Pi_{m,t}^{\xi_m}\bar{\Pi}^{1-\xi_m}}{\Pi_{t+1}}\right)^{1-\theta_m}\left(\frac{\tilde{\Pi}_{m,t}}{\tilde{\Pi}_{m,t+1}}\right) f_{m,t+1}\right\}$$

$$f_{m,t} = \left(\frac{\theta_m}{\theta_m - 1}\right)\lambda_t rer_t Y_{m,t} + (\phi_m\beta)\mathbb{E}_t\left\{\left(\frac{\Pi_{m,t}^{\xi_m}\bar{\Pi}^{1-\xi_m}}{\Pi_{t+1}}\right)^{-\theta_m} f_{m,t+1}\right\}$$

$$1 = \phi_m \left(\frac{\Pi_{m,t-1}^{\xi_m} \bar{\Pi}^{1-\xi_m}}{\Pi_{m,t}} \right)^{1-\theta_m} + (1-\phi_m)\tilde{\Pi}_{m,t}^{1-\theta_m}$$

$$\hat{\pi}_{m,t} = \frac{\beta}{1+\beta\xi_m}\hat{\pi}_{m,t+1} + \frac{\xi_m}{1+\beta\xi_m}\hat{\pi}_{m,t-1} + \frac{1}{1+\beta\xi_m}\frac{(1-\phi_m)(1-\beta\phi_m)}{\phi_m} r\hat{e}r_t \tag{5.16}$$

11. Final goods:

$$C_t = \left((1-\omega_{mc})^{\frac{1}{\gamma_c}} (C_{d,t})^{\frac{\gamma_c-1}{\gamma_c}} + \omega_{mc}^{\frac{1}{\gamma_c}} (C_{m,t})^{\frac{\gamma_c-1}{\gamma_c}} \right)^{\frac{\gamma_c}{\gamma_c-1}}$$

$$C_{d,t} = (1-\omega_{mc}) p_{d,t}^{-\gamma_c} C_t$$

$$C_{m,t} = \omega_{mc} p_{m,t}^{-\gamma_c} C_t$$

$$I_t = \left((1-\omega_{mi})^{\frac{1}{\gamma_i}} (I_{d,t})^{\frac{\gamma_i-1}{\gamma_i}} + \omega_{mi}^{\frac{1}{\gamma_i}} (I_{m,t})^{\frac{\gamma_i-1}{\gamma_i}} \right)^{\frac{\gamma_i}{\gamma_i-1}}$$

$$I_{d,t} = (1-\omega_{mi}) \left(\frac{p_{d,t}}{p_{i,t}} \right)^{-\gamma_i} I_t$$

$$I_{m,t} = \omega_{mi} \left(\frac{p_{m,t}}{p_{i,t}} \right)^{-\gamma_i} I_t$$

$$\hat{C}_t = (1-\omega_{mc}) p_d^{1-\gamma_c} \hat{C}_{d,t} + \omega_{mc} p_m^{1-\gamma_c} \hat{C}_{m,t} \tag{5.17}$$

$$\hat{C}_{d,t} = \hat{C}_t - \gamma_c \hat{p}_{d,t} \tag{5.18}$$

$$\hat{C}_{m,t} = \hat{C}_t - \gamma_c \hat{p}_{m,t} \tag{5.19}$$

$$\hat{I}_t = (1-\omega_{mi}) \left(\frac{p_d}{p_i} \right)^{1-\gamma_i} \hat{I}_{d,t} + \omega_{mi} \left(\frac{p_d}{p_i} \right)^{1-\gamma_i} \hat{I}_{m,t} \tag{5.20}$$

$$\hat{I}_{d,t} = \hat{I}_t - \gamma_i \hat{p}_{d,t} \tag{5.21}$$

$$\hat{I}_{m,t} = \hat{I}_t - \gamma_i \hat{p}_{m,t} \tag{5.22}$$

12. Monetary Policy

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\rho_R} \left[\left(\frac{\Pi_t}{\Pi}\right)^{r_\Pi} \left(\frac{Y_t}{Y}\right)^{r_Y} \left(\frac{\Delta e_t}{\Delta e}\right)^{r_{\Delta e}}\right]^{1-\rho_R} \exp(\varepsilon_{R,t})$$

$$\hat{R}_t = \rho_R \hat{R}_{t-1} + (1-\rho_R)\left[r_\Pi \hat{\pi}_t + r_Y \hat{Y}_t + r_{\Delta e}\Delta e_t)\right] + \varepsilon_{R,t} \tag{5.23}$$

13. Government

$$G_t + \frac{R_{t-1}B_{t-1}}{P_t} = \frac{B_t}{P_t} + \chi rer_t \tilde{Y}_{x,t} + TX_t$$

14. Markets clearing for goods:

$$Y_{d,t} = C_{d,t} + I_{d,t} + G_t + Y^x_{d,t}$$

$$Y_{m,t} = C_{m,t} + I_{m,t}$$

$$\hat{Y}_{d,t} = \left(\frac{C_d}{Y_d}\right)\hat{C}_{d,t} + \left(\frac{I_d}{Y_d}\right)\hat{I}_{d,t} + \left(\frac{G}{Y_d}\right)\hat{G}_{d,t} + \left(\frac{Y^x_d}{Y_d}\right)\hat{Y}^x_{d,t} \tag{5.24}$$

$$\hat{Y}_{m,t} = \left(\frac{C_m}{Y_m}\right)\hat{C}_{m,t} + \left(\frac{I_m}{Y_m}\right)\hat{I}_{m,t} \tag{5.25}$$

15. Dynamics of foreign assets (Balance of payments)

$$rer_t b^\star_t = \frac{R_{bf,t-1}}{\Pi^\star_t} rer_t b^\star_{t-1} + p_{d,t}Y^\star_{d,t} + rer_t p^\star_{x,t}Y^\star_{x,t} - rer_t Y_{m,t}$$

$$\begin{aligned}\left(\frac{rer.b^\star}{Y}\right)(\hat{rer}_t + \hat{b}^\star_t) &= \left(\frac{R_{B^\star}}{\Pi^\star}\right)\left(\frac{rer.b^\star}{Y}\right)\left(\hat{R}_{bf,t-1} - \hat{\pi}^\star_t + \hat{rer}_t + \hat{b}^\star_{t-1}\right) \\ &+ \left(\frac{p_d.Y^\star_d}{Y}\right)\left(\hat{p}_{d,t} + \hat{Y}^\star_{d,t}\right) - \left(\frac{rer.Y_m}{Y}\right)\left(\hat{rer}_t + \hat{Y}_{m,t}\right) + \left(\frac{rer.p^\star_x Y^\star_x}{Y}\right)\left(\hat{rer}_t + \hat{p}^\star_{x,t}\right)\end{aligned} \tag{5.26}$$

16. Relative prices

$$\Pi_{d,t} = (P_{d,t}/P_{d,t-1}) = (p_{d,t}/p_{d,t-1})\,\Pi_t$$

$$\Pi_{m,t} = (P_{m,t}/P_{m,t-1}) = (p_{m,t}/p_{m,t-1})\,\Pi_t$$

$$\frac{rer_t}{rer_{t-1}} = \left(\frac{e_t}{e_{t-1}}\right)\left(\frac{\Pi_t^\star}{\Pi_t}\right)$$

$$\hat{p}_{d,t} = \hat{p}_{d,t-1} + \hat{\pi}_{d,t} - \hat{\pi}_t \tag{5.27}$$

$$\hat{p}_{m,t} = \hat{p}_{m,t-1} + \hat{\pi}_{m,t} - \hat{\pi}_t \tag{5.28}$$

$$r\hat{e}r_t - r\hat{e}r_{t-1} = \Delta e_t + \hat{\pi}_t^\star - \hat{\pi}_t \tag{5.29}$$

17. Real gross domestic product (GDP) in consumption unit:

$$Y_t = C_t + p_{i,t}I_t + p_{d,t}G_t + p_{d,t}Y_{d,t}^\star + rer_t p_{x,t}^\star Y_{x,t}^\star - rer_t Y_{m,t}$$

$$\begin{aligned}\hat{Y}_t = &\left(\frac{C}{Y}\right)\hat{C}_t + \left(\frac{p_i.I}{Y}\right)(\hat{p}_{i,t} + \hat{I}_t) + \left(\frac{p_d.G}{Y}\right)(\hat{p}_{d,t} + \hat{G}_t) + \left(\frac{p_d.Y_d^\star}{Y}\right)(\hat{p}_{d,t} + \hat{Y}_{d,t}^\star) \\ &+ \left(\frac{rer.p_x^\star Y_x^\star}{Y}\right)\left(r\hat{e}r_t + \hat{p}_{x,t}^\star\right) - \left(\frac{rer.Y_m}{Y}\right)(r\hat{e}r_t + \hat{Y}_{m,t})\end{aligned} \tag{5.30}$$

18. Exogenous processes:

$$\left(\frac{X_t}{X}\right) = \left(\frac{X_{t-1}}{X}\right)^{\rho_X}\exp(\varepsilon_{X,t}) \qquad \text{for } X \in \{\zeta_{U,t}, \zeta_{I,t}, A_{d,t}, G_t, p_{x,t}^\star, \tilde{\phi}_t, Y_t^\star, R_t^\star, \pi_t^\star\}$$

$$\hat{X}_t = \rho_X \hat{X}_{t-1} + \varepsilon_{X,t} \qquad \text{for } X \in \{\hat{\zeta}_{U,t}, \hat{\zeta}_{I,t}, \hat{A}_{d,t}, \hat{G}_t, \hat{\tilde{\phi}}_t, \hat{p}_{x,t}^\star, \hat{Y}_t^\star, \hat{R}_t^\star, \hat{\pi}_t^\star\} \tag{5.31}$$

19. Set of Shocks (i.e. "exogenous" variables)

$$\{\varepsilon_{U,t}, \varepsilon_{I,t}, \varepsilon_{R,t}, \varepsilon_{A_d,t}, \varepsilon_{G,t}, \varepsilon_{\tilde{\phi},t}, \varepsilon_{p_x^\star,t}, \varepsilon_{Y^\star,t}, \varepsilon_{R^\star,t}, \varepsilon_{\pi^\star,t}\}$$

Set of "Endogenous" Variables

$$\hat{\mathbf{x}}_t = \{\hat{C}_t, \hat{I}_t, \hat{K}_t, \hat{L}_t, \hat{b}^{\star}_t, \hat{u}_t, \hat{Y}_{d,t}, \hat{Y}^{\star}_{d,t}, \hat{C}_{d,t}, \hat{I}_{d,t}, \hat{Y}_{m,t}, \hat{C}_{m,t}, \hat{I}_{m,t}, \hat{p}_{i,t}, \hat{Y}_t, \hat{G}_t, \hat{R}_t, \hat{r}_{K,t}, \hat{q}_t, \hat{w}_t, \hat{mrs}_t, \hat{rer}_t,$$
$$\Delta\hat{e}_t, \hat{\pi}_t, \hat{mc}_{d,t}, \hat{p}_{d,t}, \hat{\pi}_{d,t}, \hat{p}_{m,t}, \hat{\pi}_{m,t}, \hat{R}_{bf,t}, \hat{\Phi}_t, \hat{a}_{bf,t}, \hat{\tilde{\phi}}_t, \hat{\pi}_t, \hat{\zeta}_{U,t}, \hat{\zeta}_{I,t}, \hat{A}_{d,t}, \hat{p}^{\star}_{x,t}, \hat{Y}^{\star}_t, \hat{R}^{\star}_t, \hat{\pi}^{\star}_t\}$$

Set of Structural Parameters

$$\Theta = \{\beta, \sigma, \eta, \hbar, \delta_0, \delta_2, \kappa, \gamma_c, \gamma_i, \gamma^{\star}_d, \omega_{mc}, \omega_{mi}, \varrho, \phi_w, \theta_w, \xi_w, \phi_d, \xi_d, \phi_m, \xi_m, \alpha, \rho_R, r_\pi, r_Y, r_{\Delta e}, G/Y, rer.b^{\star}/Y,$$
$$rer.p^{\star}_x Y^{\star}_x/Y, \Pi, \Pi^{\star}, R^{\star}, \rho_{\zeta_U}, \rho_{\zeta_I}, \rho_{Ad}, \rho_G, \rho_{p^{\star}_x}, \rho_{Y^{\star}}, \rho_{R^{\star}}, \rho_{\pi^{\star}}, \sigma_{\zeta_U}, \sigma_{\zeta_I}, \sigma_{A_d}, \sigma_{p^{\star}_x}, \sigma_{Y^{\star}}, \sigma_{R^{\star}}\}$$

The other parameters or ratios appearing in the linearized equations are implicitly related the above parameters.

Chapter 6

General Conclusion

Fiscal policy is in a forefront of economic debate since the Great Depression and still holds its prominent position following the recent crises. Using to stimulate the economy or slow down the path of fiscal deficit, the effects of discretionary changes in government spending are far from known, especially those related to public management. My thesis investigates several questions related to fiscal policy and public spending management. My work includes four chapters. **Chapter 2** revisits the relationship between fiscal consolidations and government spending. It reveals a composition effect, i.e. a drastic reduction of public investment compared to government consumption, during fiscal consolidations. Sensitive to various features, this composition effect is stronger during debt distress situation and in the low phase of business cycle. At the first look at, these results show an indirect negative effect of fiscal consolidations on productivity and long-run growth. However, the contribution of public investment to growth relies on its ability to improve the stock of productive public capital. This productivity feature lies in the quality of public investment rather than its quantity. **Chapter 3** examines the impact of fiscal consolidations on the efficiency of government investment. It finds that fiscal consolidations improve the efficiency of public investment by 4 percentage points, up to 5 years after the implementation of the fiscal action. The positive effect is at work especially under IMF programs, with high perceived risk of sovereign default and when fiscal policy is accompanied by monetary policy through the depreciation of real effective exchange rate. **Chapter 4** tries to more understand the factors, related to fiscal policy, that influence the evolution of the quality of government investment. It focuses on the WAEMU zone, one of the most dynamic regions in terms of investment over the last decade. The aim of the chapter is twofold. First, it estimates the efficiency of government investment of WAEMU countries relatively to peer African and Asian countries. Second, it analyzes in which extent the financing sources of investment could affect their efficiency. As results, the chapter highlights that WAEMU countries are less efficient than other countries. In addition, the distinction between managerial and technological efficiency reveals that WAEMU countries are closer to technology frontier than peer African countries. Against this backdrop, the composition of debt, acting as main sources of government investment financing, affects the

efficiency of public investment. External debt increases the likelihood to have a good public management while domestic (regional) debt seems to not significantly affect the management of policymakers. My last chapter **(chapter 5)** investigates the effects of fiscal policy in a general equilibrium setting for African economy model. The analysis of fiscal multipliers usually hinges on either VAR models, Keynesian or neoclassical DSGE models. Due to their structural conceptions, DSGE models seem to have better fit for fiscal policy evaluations. However, the underlying assumptions of both Keynesian and neoclassical tradition lead to critics and contradictory results. As such, New Keynesian DSGE model has been developed to reconcile the previous approaches and need to be more use to assess the effects of fiscal policy. This chapter then lies in and extend the model of Smets and Wouters to evaluate the government fiscal multipliers of South Africa. it finds that change in government spending positively affect the output but with a small magnitude. The results suggest that 10 % increase in government purchases lead to a positive reaction of GDP up to 2 percentage points immediately affect the shock. This positive response lasts until 8 quarters after the shock. In other words, 1 % increase in government purchases lead to an increase in GDP by 0.2 %. The global findings of my thesis could induce two major policy implications. First, governments should design growth-friendly fiscal consolidations by paying more attention to the efficiency of spending and taxes. Currently and in the future, governments should lead fiscal policy in a high uncertain context highlighting by technology changes, global economy integration (even if we observe some protectionism trends), health pandemics as well as demographic crisis. This requires good capacity of adaptation from governments by improving social spending and tax policies, as well as building infrastructure to deliver better service. In addition, fiscal consolidations need to be accompanied by measures to protect vulnerable populations in order to be sustainable. Second, the reinforcement of conditionality around the access of domestic debts for developing countries. More specifically, domestic markets could create a competition to resources access on the regional market. The more access to domestic debt is competitive and rigorous, the more it is expected that the resource will be used wisely. This competition could take the form of a rating grid and will integrate the

factors of good governance and debt sustainability.