**Université Paris Ouest–Nanterre La Défense**
École Doctorale Économie, Organisation, Société
Laboratoire EconomiX – UMR CNRS 7235
U.F.R. SEGMI

N° attribué par la bibliothèque
|_|_|_|_|_|_|_|_|_|_|

Année 2012

# T H È S E

pour l'obtention du grade de Docteur en Sciences Économiques

Présentée par

**David Guerreiro**

Sous la direction de Valérie Mignon, Professeur à l'Université Paris Ouest–Nanterre La Défense

# LA CONVERGENCE AU SEIN D'UNE UNION MONÉTAIRE : APPROCHES PAR LA DYNAMIQUE DES PRIX ET LE TAUX DE CHANGE D'ÉQUILIBRE

Thèse soutenue publiquement à l'Université Paris Ouest–Nanterre La Défense
*Octobre 2012*

Devant le jury composé de :

| | | |
|---|---|---|
| **Mme Mariam CAMARERO** | Professeur à l'Université Jaume I (Espagne) | Examinatrice |
| **Mme Cécile COUHARDE** | Professeur à l'Université Paris Ouest | Présidente |
| **M. Gilles DUFRÉNOT** | Professeur à l'Université d'Aix-Marseille | Rapporteur |
| **M. Balázs ÉGERT** | Économiste à l'OCDE | Examinateur |
| **M. Christophe HURLIN** | Professeur à l'Université d'Orléans | Rapporteur |
| **Mme Valérie MIGNON** | Professeur à l'Université Paris Ouest | Directrice |

*À la mémoire de mon père.*

# Contents

# Remerciements

Je voudrais ici avoir une petite pensée pour tous ceux qui d'une manière ou d'une autre ont contribué à la réussite de ces trois années. Pardon d'avance à ceux que j'aurais pu oublier.

En tout premier lieu, je tiens à remercier du fond du coeur ma directrice de thèse, Valérie Mignon. J'ai énormément appris à ses côtés (que ce soit en tant que doctorant, mais aussi en tant qu'étudiant), je lui dois par conséquent beaucoup. Son investissement sans faille, sa disponibilité, son écoute, mais aussi ses conseils toujours avisés et son aide m'ont permis de réaliser cette thèse dans des conditions idéales. Qu'elle trouve par ces quelques mots toute ma gratitude et toute ma reconaissance.

Je veux aussi adresser mes sincères remerciements aux membres qui ont accepté de composer mon jury de thèse. Gilles Dufrénot et Christophe Hurlin qui ont bien voulu être rapporteurs; Mariam Camarero et Balázs Égert qui ont donné leur accord pour être examiteurs; et enfin Cécile Couharde qui, j'en suis sûr, fera une très bonne présidente!

Certains chapitres de cette thèse ont bénéficié de l'apport de coauteurs. Je veux ici redire à Cécile Couharde, à Issiaka Coulibaly, à Marc Joëts, et à Valérie Mignon combien j'ai été honoré de travailler avec eux. Je veux aussi remercier Benoît Chèze : bien que n'ayant pas vraiment collaboré avec lui, je n'oublie pas sa précieuse aide lors de la réalisation de mon mémoire de Master 2 qui m'aura permis de décrocher un contrat doctoral!

Je n'oublie pas non plus toutes les personnes avec qui j'ai travaillé dans le cadre de mon monitorat : Aymen Belgacem (que de fou-rires, particulièrement lors de la surveillance des examens), Salem Boubakri (et son magnifique "Qui-c'est-qui-sait-siffler?"), Sandrine Lardic, Thérèse Quang, Sessi Tokpavi, et Alisack Vannavong (merci pour son sérieux dans

la gestion des étudiants, et pour sa bonne humeur lors des innombrables pauses café et pauses déjeuner).

Un petit mot aussi pour tous les collègues de bureau... Merci au bureau 602, plus particulièrement à Sélim Mankaï, à John Perdomo (nous n'avons toujours pas tranché... Les subprimes? Crise de surproduction ou mauvaise évaluation du risque?), ainsi qu'à Sandrine Kablan. Merci aussi au 611 bis, et son "fondateur", Marc Joëts, alias "The Boss". Merci à Vincent Brémond (inoubliables journées de l'AFSE), à Blaise Gnimassoun (sûr, on fera un papier ensemble), à Irfan Kazi (et son fameux mug Johnny Halliday), à Tovonony "Max" Razafindrabe (pour toi aussi la fin est proche, courage!!).

Lors de la réalisation de la thèse, j'ai par ailleurs pu profiter des conseils et des remarques d'Hiroya Akiba, d'Agnès Bénassy-Quéré, de Jamel Saadaoui, de Karim Jebri ainsi que de l'assistance technique d'Abdou Rabba.

Enfin, j'aimerai avoir une pensée pour mes proches qui m'ont toujours soutenu tout au long de ces trois années. Merci à Joanne pour ses relectures, mais aussi son inspiration! Merci à tous mes amis, plus particulièrement les "potes de galère", Camille, Emmanuel, Kanü, Nelly! Enfin, un grand merci à ma famille, j'espère les avoir rendu fiers.

# Résumé

Si l'intégration n'est pas un processus nouveau, elle a, depuis la fin de la Seconde Guerre Mondiale, sans cesse transformé l'architecture économique internationale. En parallèle à ce phénomène de mondialisation, différentes sortes d'accords intensifiant l'intégration régionale ont vu le jour. Parmi ces derniers, les unions monétaires, comme la zone euro ou la zone CFA, présentent un intérêt pratique tout particulier car elles conditionnent aussi bien les politiques monétaires que les politiques budgétaires des pays membres. Cette thèse s'attache à étudier la convergence dans ce cadre contraint par l'intermédiaire de la dynamique de prix et des taux de change d'équilibre. Trois thèmes sont abordés : la dynamique des prix au sein de la zone euro, les interactions de cette dynamique avec l'évolution des différentiels d'intérêts connus lors de la crise de la dette, et enfin, la soutenabilité de la zone CFA.

Dans le premier chapitre, nous présentons de manière détaillée les caractéristiques et les propriétés des unions monétaires. Dans un premier temps, après avoir défini les unions monétaires et donné les raisons économiques de leur formation, nous passons en revue les coûts qui leur sont associés. Dans un second temps, nous développons les points de théorie qu'elles ont engendrés, principalement les critères d'optimalité, mais aussi les effets dynamiques. Enfin, nous présentons les deux zones monétaires que nous étudions, à savoir l'UEM et la zone CFA, en remémorant les grandes étapes de leur construction ainsi que leurs principaux modes de fonctionnement.

Le deuxième chapitre s'intéresse au processus de convergence des prix de onze pays appartenant à la zone euro par rapport à l'Allemagne entre Janvier 1970 et Juillet 2011. En nous appuyant sur des modèles à transition lisse, nous montrons que la convergence est non-linéaire et qu'elle dépend de l'importance des écarts de prix constatés : pour la plupart des pays, elle n'a lieu que lorsque les différentiels de prix par rapport à l'Allemagne dépassent

un certain seuil. Par ailleurs, nos résultats mettent en avant l'existence d'une hétérogénéïté entre pays dans les vitesses de convergence, qui peut être expliquée par l'évolution de la compétitivité-prix, les rigidités du marché du travail, mais aussi les schémas de spécialisation.

**Mots-clés :** Convergence des prix, zone euro, modèles à transition lisse, demie-vie. **Classification JEL :** C22, E31, F15, F41.

Le troisième chapitre porte lui aussi sur l'homogénéïté de la dynamique des prix au sein de la zone euro, mais traite le problème de manière différente. Reprenant nos séries de prix sur la période allant de Janvier 1970 à Juillet 2011, nous testons la version absolue de l'hypothèse de la Parité des Pouvoirs d'Achat (PPA) par le biais de tests de racine unitaire et de cointégration en panel de deuxième et de troisième générations. Dans l'ensemble, la dynamique des prix apparaît hétérogène et dépendante des périodes d'évolution de l'UEM, ainsi que des groupes de pays considérés. Plus précisément, alors que la PPA est vérifiée pour les pays appartenant au coeur de l'Europe, elle n'est pas valable pour les pays périphériques du Nord. Pour les pays périphériques du Sud, elle est respectée uniquement avant le lancement de l'euro.

**Mots-clés :** Convergence des prix, zone euro, tests de racine unitaire en panel, demie-vie. **Classification JEL :** C22, E31, F15, F41.

Le quatrième chapitre a pour objet de relier de manière formelle les déséquilibres externes à la crise de la dette souveraine que connait l'UEM depuis 2009. En nous basant sur une approche CHEER (Capital enHanced Equilibrium Exchange Rate), qui rattache le marché des biens au marché des capitaux via le taux de change anticipé, nous montrons que lorsqu'un pays appartenant à une union monétaire fait face à un déséquilibre externe vis-à-vis d'un autre pays membre, l'écart de taux d'intérêts correspondant tend à s'accroître. De plus, lorsque ces désquilibres persistent, ils peuvent déclencher une crise de la balance des paiements. Nos résultats indiquent qu'un tel phénomène semble être à l'oeuvre pour les pays européens sous assistance financière internationale.

**Mots-clés :** balance des paiements, CHEER, crise de la dette, déséquilibres externes, zone euro. **Classification JEL :** F33, F34, G01.

Le dernier chapitre vise à expliquer pourquoi les pays de la zone CFA, alors qu'ils ne respectent pas les critères d'optimalité, ont réussi à maintenir leur union monétaire pendant

des décennies. Nous avançons l'idée que bien que non optimale, la zone est au moins soutenable. Nous testons cette hypothèse en nous fondant sur l'approche comportementale du taux de change d'équilibre (BEER). Après avoir étudié les processus d'ajustement vers le sentier d'équilibre de la zone CFA et d'un échantillon composé d'autres pays d'Afrique Subsaharienne, nous les comparons. Nos résultats attestent que relativement aux autres pays Subsahariens, la zone CFA a favorisé les équilibres internes et externes, et facilité les ajustements aussi bien au niveau de l'ensemble de la zone, qu'au niveau individuel.
**Mots-clés :** taux de change d'équilibre, zone CFA, zone monétaire optimale, zone monétaire soutenable. **Classification JEL :** F31, F33, C23.

# Summary

If integration is not a new process, it has constantly transformed the international economic architecture since the end of World War II. Parallel to this movement of globalization, various agreements deepening the regional integration, as in Europe, have been created. Among them, monetary unions, as the Eurozone or CFA franc zone, are particularly interesting since they condition the monetary but also the budgetary policies of their member countries. This thesis seeks to study the convergence under this constrained framework through the price dynamics and the equilibrium exchange rates. Three issues are discussed: the price dynamics inside the Eurozone, the interactions between this dynamics and the evolution of the interest rates differentials experienced during the sovereign debt crisis, and finally the sustainability of the franc CFA zone.

The first chapter is dedicated to an exhaustive presentation of characteristics and properties of monetary unions. Initially, after having defined the currency unions and announced the economic reasons of their formation, we review the costs associated to them. Then we develop the theoretical purposes they raised, mainly the optimality criteria, but also their dynamic effects. Finally, we introduce the two monetary unions under study, namely the Eurozone and the CFA franc zone, by remembering the milestones of their constitution and functioning.

In the second chapter, we investigate price level convergence with Germany in eleven countries belonging to the Eurozone between January 1970 and July 2011. Relying on smooth transition regression models, we show that the price convergence process is nonlinear, depending on the size of the price differential: for most countries, price convergence occurs only when price differentials with Germany exceed a certain threshold. Moreover, our findings put forward some heterogeneity across the Eurozone members in terms of price convergence speed, that can be explained by the evolution of price-competitiveness, rigidi-

ties in labor markets, but also by specialization patterns.

**Keywords:** price convergence, Eurozone, smooth transition regression models, half-life. **JEL Classification:** C22, E31, F15, F41.

The third chapter also addresses the homogeneity of price dynamics, but in a different way. Relying on monthly data over the January 1970-July 2011 period, we test for the absolute purchasing power parity (PPP) hypothesis through the implementation of second and third-generation panel unit root and cointegration tests. Our results show that price dynamics are heterogeneous depending on both the time period and the considered group of countries. More specifically, while PPP is validated for the core EMU countries, this hypothesis does not hold for Northern peripheral economies. Turning to the Southern countries, PPP is observed only before the launch of the euro.

**Keywords:** price convergence, Eurozone, panel unit root tests, half-life. **JEL Classification:** C22, E31, F15, F41.

The fourth chapter is interested in linking formally external disequilibriums to the sovereign debt crisis the EMU is experiencing since 2009. Relying on the CHEER approach that connects the goods market to the capital market, we show that when a country belonging to a monetary union faces external disequilibrium relative to its main partner, the corresponding interest rate differential increases. Moreover, when these imbalances are persistent, it may trigger a balance of payments crisis. Our findings indicate that this phenomenon seems to be at play for the European countries under international assistance.

**Keywords:** balance of payments crisis, CHEER, debt crisis, external imbalances, Eurozone. **JEL Classification:** F33, F34, G01.

The last chapter aims at explaining why the CFA countries have successfully maintained a currency union for several decades, despite failing to meet many of optimum currency area criteria. We suggest that the CFA zone, while not being optimal, has been at least sustainable. We test this sustainability hypothesis by relying on the Behavioral Equilibrium Exchange Rate (BEER) approach. In particular, we assess and compare the convergence process of real exchange rates towards equilibrium for the CFA zone countries and a sample of other sub-Saharan African (SSA) countries. Our findings evidence that internal and external balances have been fostered and adjustments facilitated in the CFA zone as a whole—compared to other SSA countries—as well as in each of its member countries.

**Keywords:** Equilibrium exchange rates, CFA zone, Optimum Currency Areas, currency union sustainability. **JEL Classification:** F31, F33, C23.

# Introduction Générale

*Une proposition scientifique, c'est comme une bulle du Pape sur la régulation des naissances, ça ne prêche que les convertis!*

Pierre Bourdieu, in Question de Sociologie (1984).

*Toute science serait superflue si l'apparence et l'essence des choses se confondaient.*

Karl Marx, in Le Capital, Tome III (1867).

Depuis la fin de la Seconde Guerre Mondiale, un processus économique modifie continuellement l'architecture mondiale : l'intégration. Si ce dernier terme recouvre une acception assez floue pour Perroux (1954), pour Balassa (1961) au contraire, l'intégration s'assimile à une volonté (politique) de supprimer les discriminations portant sur des considérations d'appartenance nationale entre unités de production.

Un premier phénomène d'intégration s'amorce dès la fin de la première révolution industrielle comme en témoignent certains accords de libre-échange—notamment entre la France et le Royaume-Uni avec le Traité de libre-échange Franco-Anglais de 1860—mais surtout l'intensification de la colonisation qui non seulement fournit de nouveaux débouchés mais aussi de nouvelles sources d'approvisionnement aux entreprises des pays fraîchement industrialisés. Le développement des Investissements Directs à l'Etranger (IDE) qui en découlent initie par ailleurs un mouvement de multinationalisation des firmes (Michalet, 1976). Toutefois, la Première Guerre Mondiale, combinée à la crise de 1929 et à la dépression qu'elle engendre, sonnent le glas du libre-échange et marquent un retour au protec-

tionnisme.

Il faut attentre les accords du GATT (*General Agreements on Tariffs and Trade*) pour qu'une nouvelle phase d'intégration se propage. Signés en 1947 par 23 pays, ils ont pour but de favoriser le libre-échange dans un cadre multilatéral par l'abaissement et la supression négociés des droits de douane et des barrières non-tarifaires. Au cours des différents cycles de négociations (*rounds*), les secteurs concernés par ces accords, mais aussi les pays y prenant part, ne cessent de croître (115 pays en 1993). En 1994, les accords de Marrakech remplacent le GATT par un organisme international, l'Organisation Mondiale du Commerce (OMC). Cette dernière possède des pouvoirs et des compétences renforcés par rapport au GATT. En effet, elle est dotée i) d'un organe permanent permettant la mise en oeuvre de politiques commerciales, ii) d'un Organe de Règlement des Différents (ORD) permettant de statuer sur la légalité de certaines pratiques et le cas échéant de sanctionner les pays en infraction, enfin iii) elle coopère avec les autres grandes institutions internationales, telles que le Fonds Monétaire International (FMI) et la Banque Mondiale, afin d'harmoniser les législations internationales.

Avec l'internationalisation des échanges, on assiste comme lors de la première vague d'intégration à une multinationalisation des firmes, une firme multinationale se définissant comme une entreprise possèdant au moins une unité de production en dehors de son pays domestique, et dont le cadre d'activité est mondial. Au centre de cette évolution, on trouve les IDE qui sont des flux de capitaux destinés à prendre le contrôle ou à développer des activités productives à l'étranger. Trois stratégies majeures sont à la base de tels investissements (Michalet, 1976):

1. L'approvisionnement : ces capitaux assurent l'exploitation et l'acquisition de matières premières et énergétiques à faible coût.

2. Les débouchés : produire localement est une solution pour contourner les entraves éventuelles à l'échange international. Cela permet par ailleurs de pénétrer de nouveaux marchés et de se soustraire à la concurrence internationale sur les marchés domestiques.

3. La rationalisation des coûts : la perte d'un avantage technologique ou le faible coût de la main d'oeuvre peut pousser une entreprise à délocaliser sa production afin d'améliorer sa compétitivité. De manière générale, la rationalisation passe par la

pleine exploitation des avantages comparatifs de chaque pays dans lequel la firme est implantée, cela amène à une division internationale des processus de production (DIPP).

Si le mouvement de multinationalisation est resté assez modeste jusque dans les années 1970 (avec des flux d'IDE au niveau mondial d'environ 13.3 milliards de dollars en 1970), il s'accélère dans les années 1980 et 1990 (les flux passant de 54 à 1089 milliards de dollars de 1980 à 2000, et les stocks de 699 à 7445 milliards). Le point culminant a lieu avant la crise de 2008 avec des flux d'IDE atteignant 1970 milliards en 2007 et un stock évalué à 17850 milliards[1].

En plus des versants économiques et commerciaux, l'intégration recouvre aussi un aspect financier. S'il est vrai que l'on trouve dès les années 1950 des euro-marchés qui se développent jusque dans les années 1970, c'est pendant les années 1980 que l'intégration financière prend son essor. Sous l'effet des "3D" (Bourguinat, 1999) et des progrès de l'informatique, on assiste à la création d'un unique marché de capitaux mondial fonctionnant 24 heures sur 24:

- Le décloisennement permet d'unifier les marchés financiers d'un point de vue géographique, fonctionnel et temporel. Ainsi, on *déspécialise* (Bourguinat, 1999) les agents (jobbers/brokers), les institutions (banque d'affaires/banque de dépôts), et on fusionne les marchés (marché monétaire/marché financier/marché des changes).

- La dérèglementation s'attaque aux barrières entravant la libre circulation des capitaux. Elle donne par ailleurs lieu à des innovations financières qui rendent les marchés plus profonds, plus liquides, et qui étendent les possibilités de couverture contre les risques (notamment de taux ou de contrepartie).

- La désintermédiation s'attache à rendre direct l'accès aux marchés, sans nécessiter un intermédiaire : les agents à capacité et à besoin de financement sont mis en contact sur le marché, et non plus par le biais d'une institution financière (généralement une banque). On passe ainsi d'une économie d'endettement financée par des intermédiaires à une économie des marchés financiers (Hicks, 1974). Bourguinat (1999) montre par ailleurs que cette désintermédiation s'est faite par le biais de la titrisation, à savoir, "*placer des effets à court terme renouvelables et qui donnent à l'emprunteur l'assurance d'un financement à long terme*".

[1]Les données proviennent de la base de données de la CNUCED : http://unctadstat.unctad.org.

Cependant, l'intégration n'est pas un processus uniforme. C'est au contraire une marche asymétrique qui est liée à la volonté et à la capacité d'intégration des pays concernés. En parallèle à la mondialisation[2], des phénomènes régionaux d'intégration plus étroite—communément appelés régionalisation—se sont développés après 1945[3]. Ces mouvements régionaux prennent des formes différentes selon le degré d'intégration visé. On peut, à ce titre, faire appel à Balassa (1961) qui a théorisé les différentes étapes de l'intégration régionale grâce à sa célèbre typologie:

1. La zone de libre-échange se caractérise par l'abandon des barrières tarifaires et non-tarifaires à l'échange entre les membres qui la constituent.

2. L'union douanière est une zone de libre échange complétée par un tarif extérieur commun.

3. Le marché commun se distingue de l'union douanière par la libre circulation des facteurs de production.

4. L'union économique s'attache à coordonner les politiques économiques.

5. L'union économique et monétaire reflète l'intégration complète par la mise en circulation d'une monnaie commune.

Selon cette vision, chaque étape en direction de l'union monétaire induit une intégration plus poussée, la première étant l'aboutissement de la dernière. Toutefois, la régionalisation n'est pas le déroulement linéaire et ordonné que laisse supposer cette typologie. Plusieurs exemples montrent que certaines étapes ont parfois été sautées. On peut notamment prendre les cas de la zone euro et de la zone CFA (Communauté (ou Coopération) Financière d'Afrique), où la réalisation des unions économiques avant la mise en place d'une monnaie commune est très discutable.

De manière plus générale, malgré la multitude d'accords existants, le degré d'intégration des constructions régionales demeure relativement faible. En effet, la majorité des traités portent sur l'établissement de zones de libre-échange qui visent uniquement à renforcer

[2]Qui peut se définir comme une intégration mondiale dont les caractéristiques sont i) une internationalisation des économies (notamment par le commerce.), ii) une multinationalisation de firmes, et iii) une globalisation financière

[3]De nouveau, des exemples d'intégration régionale peuvent être trouvés lors du XIXème siècle. On peut notamment citer le *Deutsche Zollverein* en 1833, ou l'Union Monétaire Scandinave (formée par le Danemark, la Norvège et la Suède) en 1873.

les liens commerciaux au sein d'une région, comme c'est le cas pour l'ALENA[4] ou pour l'ASEAN[5]. Quelques marchés communs, comme le MERCOSUR[6], sont à noter. Enfin, les seules unions monétaires (en dehors des Etats fédéraux comme les Etats-Unis ou le Canada) que l'on peut recenser sont:

- L'Union Economique et Monétaire (la zone Euro) en Europe.
- La zone CFA, d'une part, et la zone RAND[7] d'autre part, en Afrique.
- L'Union Monétaire de la Caraïbe de l'Est en Amérique Centrale.

Bien que peu nombreuses, ces unions monétaires présentent un intérêt particulier qui est à la base de l'objet de notre démarche. **Plus précisément, l'objectif de cette thèse est d'étudier la convergence en union monétaire.** En tant que degré final d'intégration, une monnaie unique implique une parfaite mobilité des biens, des services, mais aussi des facteurs, dans un contexte où les taux de change entre membres sont fixés de manière irrévocable. Ce cadre restreint les possibilités d'ajustements monétaires entre les membres et contraint leurs trois principaux leviers macroéconomiques en matière de politique économique (Montiel, 2009), à savoir:

- la politique de change,
- la politique monétaire,
- la politique budgétaire/fiscale.

En effet, l'intégration suppose i) l'abandon de la politique de change étant donné la fixité des parités, ii) l'abandon d'une politique monétaire nationale au profit d'un organisme supranational ayant des considérations "fédérales". Enfin, iii) les politiques budgétaires et fiscales peuvent rester des prérogatives nationales (tout dépend de la nature de l'union monétaire), mais elles sont contraintes par l'interdépendance accrue qu'engendre l'intégration avec les autres membres. Des politiques divergentes peuvent conduire à des déséquilibres internes et/ou externes dont les effets ne peuvent être corrigés par des instruments monétaires (le taux de change et l'inflation essentiellement). De plus, toute une série d'autres questions concernant l'organisation et la gouvernance d'une zone monétaire ainsi que les problèmes

[4]Association de Libre Echange Nord Américaine, créée en 1992.
[5]*Association of Southeast Asian Nations* créée en 1967.
[6]Marché Commun du Sud, comprenant l'Argentine, le Brésil, le Paraguay et l'Uruguay, créée en 1991.
[7]Composée de l'Afrique du Sud, le Lesotho, la Namibie et le Swaziland.

d'asymétrie se posent aussi.

C'est avec les travaux pionniers de Mundell (1961) sur la zone géographique adéquate d'une monnaie que débute l'analyse théorique des problèmes engendrés par les unions monétaires. Le sujet des Zones Monétaires Optimales (ZMO) a été largement débattu depuis, et a donné naissance à une littérature foisonnante (Sénégas, 2010). Il faut toutefois remarquer que l'attention portée à ce sujet dans la littérature académique a été fluctuante. Ainsi que le remarque Tavlas (1993), en reprenant la citation d'Ishiyama (1975), la théorie des ZMO a été souvent considérée comme "une discussion principalement scholastique n'ayant apporté qu'une faible contribution aux problèmes pratiques des taux de change et des réformes monétaires". Comme l'évoque Sénégas (2010), elle est avant les années 1990 une théorie en quête de faits. Cependant, la volonté des pays européens de se doter d'une monnaie unique à partir de 1992 et du traité de Maastricht, a généré un regain d'intérêt pour la théorie des ZMO qui a poussé Krugman (1993b) à en faire "la pièce maîtresse de l'économie monétaire internationale".

Plusieurs courants de pensée coexistent au sein de la littérature sur les ZMO. Pour les fondateurs (tels que Mundell, 1961 ; McKinnon, 1963 ; Kenen, 1969 ; Fleming, 1971 ; et Magnifico, 1973) l'optimalité d'une zone est conditionnée par l'existence d'un arbitrage entre l'homogénéité des membres et leur degré d'ajustements réels. Lorsque les membres sont homogènes, des politiques monétaires d'ensemble peuvent être appliquées pour résorber des déséquilibres (ici le *one-size-fits-all* serait respecté). Dans le cas contraire, la politique monétaire est déstabilisatrice car incompatible avec les situations de tous les membres. Des ajustements réels, tels que des baisses de salaires, de prix et une augmentation de la mobilité des facteurs de production (notamment le travail) doivent être privilégiés. Les théories développées à partir des années 1990 contestent cette approche statique et se concentrent sur les effets propres engendrés par une union monétaire. D'un côté, les tenants de la théorie des ZMO endogènes (par exemple Frankel et Rose, 1998) avancent que la monnaie constitue une barrière à l'échange, et qu'une monnaie commune, par le biais du commerce, permet une synchronisation des fluctuations économiques. A l'opposé, Krugman (1993a), mais aussi Kalemli-Ozcan et al. (2001), avancent qu'une monnaie unique tend à accroître les spécialisations de chaque membre (à la fois par le biais du commerce, mais aussi par celui de l'intégration financière), rendant leurs cycles économiques plus disparates.

Aujourd'hui, la crise de la dette souveraine que connaissent certains pays de la zone euro est en train de remettre en cause la pérennité de l'union monétaire, redonnant à cette thématique une actualité toute particulière. A la suite de la crise des subprimes en 2008, l'endettement et le déficit de certains Etats combinés à de faibles perspectives de croissance ont conduit les agences de notation à dégrader les notes de plusieurs pays de la zone euro, déclenchant par là même une forte défiance des marchés vis-à-vis des PIIGS[8]. La Grèce tout d'abord, puis l'Irlande et le Portugal ensuite, ont été forcés de demander une aide financière internationale à la Troïka[9] en 2009, car les taux de (re)financement sur les marchés étaient devenus prohibitifs. Par ailleurs, notons qu'au moment où nous écrivons cette introduction, Chypre et l'Espagne ont aussi demandé assistance, et les plans de secours sont sur le point d'être dévoilés.

Ces plans d'aide ne sont toutefois pas sans contreparties. Ils nécessitent l'adoption de mesures d'ajustements structurels similaires à celles mises en oeuvre dans les pays en voie de développement ayant fait appel au FMI dans les années 1980 et 1990. Basées sur une logique de l'offre, ces politiques visent à rétablir la compétitivité en diminuant la demande effective et prennent la forme d'une dévaluation interne (baisses de salaires, baisses des dépenses publiques, privatisations, et flexibilisation du marché du travail). Ces mesures sont cependant vivement critiquées (Stiglitz, 2010) non seulement pour leur inefficacité (aggravation de la récession et du poids de la dette), mais aussi pour leur coût social (fort taux de chômage, baisse des revenus). Certains économistes de renom, tels que Paul Krugman ou Joseph Stiglitz (respectivement prix Nobel 2008 et 2001), préconisent des politiques différentes en rappelant les échecs du *Gold Exchange Standard* après la crise de 1929 et la dépression des années 1930. Dans quelques entretiens accordés à la presse française[10], ils plaident pour une politique monétaire expansive au sein de l'UEM capable d'amorcer une relance économique : une hausse de l'activité ainsi que de l'inflation à l'intérieur de la zone faciliterait, selon eux, les nécessaires ajustements des pays périphériques en réduisant les coûts sociaux (Krugman, 2012). Il vont même jusqu'à avancer que si de telles dispositions ne peuvent être prises à cause de blocages politiques, alors une sortie ordonnée de l'euro suivie d'une dévaluation serait pour certains pays (notamment la Grèce) une meilleure solution que de suivre les politiques de la Troïka (considérée par Stiglitz (2011) comme

[8]Parfois appelés aussi GIPSI, ce sont les pays européens périphériques, c'est-à-dire le Portugal, l'Irlande, l'Italie, la Grèce et l'Espagne.

[9]Cette entité regroupe la Banque Centrale Européenne, le Fonds Monétaire International et l'Union Européenne.

[10]Le Monde, Marianne 2.

la “pire des punitions”). Néanmoins, ce dénouement n’est pas sans risques. D’un point de vue institutionnel, il n’existe aucune clause dans les traités européens permettant de sortir de la monnaie unique. D’un point de vue économique, la réaction des marchés est à craindre : des attaques spéculatives contre les pays sortant de l’euro ainsi que contre ceux qui sont vus comme des maillons faibles de l’union sont plus que probables. De plus, ainsi que l’évoquent Coudert et al. (2012) le poids de la dette serait encore accru étant donné que cette dernière est libellée en monnaie étrangère.

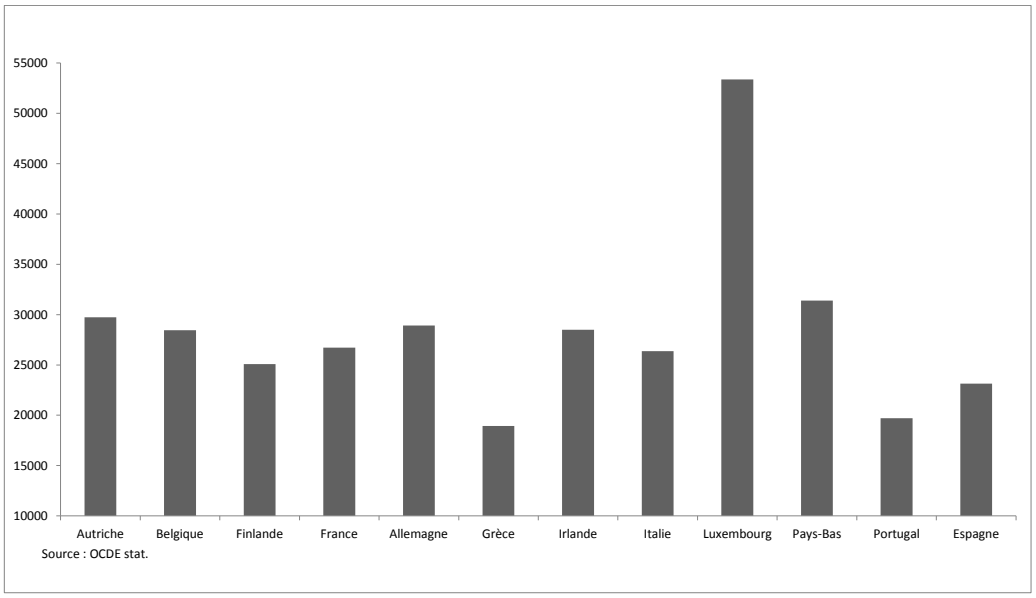
Les Etats fondateurs de la zone euro ont pourtant dès le lancement de l’UEM établi un certain nombre de gardes-fou budgétaires et monétaires afin de constituer une union monétaire cohérente et d’éviter le même type de crises (et d’erreurs) survenues pendant le SME. Les accords de Maastricht (1992) complétés par le Pacte de Stabilité et de Croissance (PCS) en 1997, énoncent un certain nombre de critères fondamentaux en matière de convergence que les pays membres doivent respecter, tels que la stabilité des prix, qui stipule que le taux d’inflation d’un pays membre ne doit pas excéder de plus de 1,5 points la moyenne des trois taux les plus bas au sein de l’union, ou la convergence budgétaire contraignant les déficits à ne pas dépasser plus de 3% du PIB, et la dette plus de 60% du PIB. Ces mesures ont pour but essentiel d’assurer le minimum d’homogénéïté nécessaire à la stabilité de l’union ainsi qu’à la mise en oeuvre d’une politique monétaire commune qui soit efficace (voire optimale). En effet, d’éventuels écarts d’inflation[11], ou la conduite de politiques budgétaires antagonistes aboutissent à des différentiels de compétitivité (via le taux de change réel) entre membres de la zone qui se traduisent, à leur tour, par l’apparition de chocs asymétriques ne pouvant être résorbés que par des ajustements réels. Malgré tout, ces critères présentent un talon d’Achille : ils présupposent que les pays concernés par ces mesures forment déjà en début de période (c’est-à-dire juste avant le lancement de la monnaie unique) un ensemble relativement homogène. Or, un examen rapide des PIB par tête (Figure 1) montre les disparités existantes au sein de la zone euro.

Dans un contexte d’union monétaire incomplète, l’hétérogénéïté peut être à l’origine de quatre types de chocs asymétriques qui ont des conséquences sur la dynamique des prix, ainsi que le montrent Coudert et al. (2012):

1. Un choc de taux d’intérêts et de primes de rique.
2. Une non-synchronisation des cycles.

[11] Comme lors de la sortie du SME en 1992 de l’Espagne et de l’Italie.

Figure 1: **PIB PPA par tête dans douze pays de la zone euro en 1998 (en euros)**




3. Un effet de type Balassa/Samuelson.

4. Un choc d'inflation importée via le taux de change effectif réel.

S'il est vrai que le premier de ces quatre chocs était prévu par les économistes, et même considéré comme favorable pour les pays périphériques, puisque ces derniers bénéficieraient de taux d'intérêts en baisse, les effets réels ont été pernicieux. Loin de favoriser les investissements productifs qui auraient impulsé la croissance, les faibles taux d'intérêts ont conduit à une mauvaise allocation des ressources. Les capitaux ont ainsi alimenté la bulle immobilière en Espagne, en Grèce, et en Irlande, où les montants des prêts immobiliers ont augmenté respectivement de 500%, 400% et 800% entre 1998 et 2007, et ont aussi financé la consommation en Espagne et au Portugal, avec des taux d'endettement des ménages qui sont passés de 50% et 40% en 1998, à 84% et 96% en 2008 (Bini Smaghi, 2011)[12]. Contrairement à ce que prévoyait la théorie des ZMO endogènes, l'euro ne semble pas

[12]D'autres études telles que Deutsche Bank (2010) ou Eichengreen (2010) soutiennent la même idée.

avoir synchronisé les fluctuations économiques. D'après Andersson et al. (2009) la raison principale des différentiels d'inflation dans l'UEM repose sur des positions différentes au sein du cycle. Concernant l'effet Balassa/Samuelson, les études (Honohan et Lane, 2003; Égert (2007); Bulir et Hurnik, 2008; Andersson et al., 2009; Beck et al., 2009; ou Rabanal, 2009) tendent à montrer qu'il n'a eu qu'un faible impact depuis l'avènement de la monnaie unique. Enfin, la localisation du commerce ne semble pas avoir eu d'effet significatif sur l'inflation (Bussière et al., 2011).

Notre thèse a pour objet d'approfondir ces éléments en apportant diverses contributions originales à la littérature sur les unions monétaires. Une première contribution consiste à relier les asymétries précédemment mentionnées à la crise de la dette actuelle. Plus spécifiquement, nous soutenons l'idée que ces asymétries dans la dynamique des prix entre les pays périphériques et les pays du coeur de l'Europe sont essentielles à la compréhension de la crise de la dette souveraine car elles sont à la base des déséquilibres macroéconomiques existants au sein de la zone euro. Toutefois, nous prenons garde à distinguer les causes des asymétries car elles déterminent la nature des déséquilibres. En effet, il peut exister de "bons" déséquilibres (Blanchard et Giavazzi, 2002) lorsqu'ils sont la conséquence d'un rattrapage économique (effet Balassa/Samuelson), et de mauvais déséquilibres liés à une perte de compétitivité (Fleming, 1971).

Une deuxième contribution de notre thèse se situe à un niveau plus théorique. Comme souvent en économie, les crises majeures bouleversent la pensée économique, la première mettant à nu les limites de la seconde. La théorie dominante sur les zones monétaires s'est toujours attachée à déterminer les moyens d'assurer l'optimalité de la zone. Néanmoins, elle présente un certain décalage avec le caractère *de jure* de la plupart des unions monétaires existantes. Comme le souligne Goodhart (1998), elle présente un caractère trop normatif qui la prive de tout pouvoir explicatif ou prédictif. Basée sur une vision "Métaliste"—qui considère que la valeur de la monnaie découle du colatéral auquel elle est adossée—plutôt que sur une vision "Chartaliste"—pour qui la source de valeur se trouve dans la confiance qu'inspire l'autorité d'émission— la théorie des ZMO ne prend pas en compte les aspects de politique économique de la monnaie que sont la souveraineté et les liens étroits entre émission monétaire et politique fiscale. Elle se focalise uniquement sur des préoccupations d'économie pure telle que l'efficacité, délaissant les aspects historiques et politiques.

Cela peut être un inconvénient sérieux lorque l'on s'intéresse aux processus et aux motivations qui conduisent à la formation d'une union monétaire, car dans les faits elles sont décidées sur d'autres bases que les seuls gains économiques. Aussi cela rend-il le prisme de l'optimalité quelque peu biaisé, voire trop restrictif pour appréhender tous les enjeux soulevés par une union monétaire comme les préoccupations politiques et/ou historiques. Cette affirmation recoupe en partie les thèses développées par Mintz (1970) ou Haberler (1970), pour qui l'intégration politique est fondamentale. Afin de lever ces limites, nous adoptons une approche plus positive des unions monétaires. Partant du principe que l'optimalité est une hypothèse trop forte, mais que sans un minimum de cohérence (et d'ajustements) économiques une zone monétaire est vouée à l'échec, nous introduisons l'hypothèse de soutenabilité. Nous nous proposons de tester cette hypothèse sur une union monétaire qui ne semble pas respecter les critères d'optimalité mais qui paradoxalement jouit d'une réelle longévité: la zone CFA.

Un troisième apport de notre thèse se situe au niveau économétrique. Nous contribuons à la littérature empirique sur les unions monétaires en recourant à une large palette de techniques économétriques traitant de la non-stationnarité, tant dans le domaine des séries temporelles que dans le domaine des données de panel. En séries temporelles, le cadre d'analyse peut être linéaire, avec l'emploi notamment de modèles vectoriels autorégressifs cointégrés (Juselius, 2006), ou non linéaire avec l'utilisation des modèles à transition lisse (Teräsvirta, 1994). En économétrie des données de panel, notre cadre d'analyse reste linéaire avec la mise en oeuvre de tests de racine unitaire et de cointégration non seulement de deuxième, mais aussi de troisième générations.

Notre thèse s'articule autour de cinq chapitres. Dans le premier, nous nous attachons à présenter de manière approfondie les caractéristiques et les propriétés des unions monétaires. Dans un premier temps, après avoir défini les unions monétaires et donné les raisons économiques de leur formation, nous passons en revue les coûts qui leur sont associés. Dans un second temps, nous développons les points de théorie qu'elles ont engendrés, principalement les critères d'optimalité, mais aussi les effets dynamiques. Enfin, nous présentons les deux zones monétaires que nous étudions, à savoir l'UEM et la zone CFA, en remémorant les grandes étapes de leur construction ainsi que leurs principaux modes de fonctionnement.

Le deuxième chapitre s'intéresse au processus de convergence des prix de onze pays appartenant à la zone euro par rapport à l'Allemagne entre Janvier 1970 et Juillet 2011. En nous appuyant sur des modèles à transition lisse, nous montrons que la convergence est non-linéaire et qu'elle dépend de l'importance des écarts de prix constatés : pour la plupart des pays, elle n'a lieu que lorsque les différentiels de prix par rapport à l'Allemagne dépassent un certain seuil. Par ailleurs, nos résultats mettent en avant l'existence d'une hétérogénéïté entre pays dans les vitesses de convergence, qui peut être expliquée par l'évolution de la compétitivité-prix, les rigidités du marché du travail, mais aussi les schémas de spécialisation.

Le troisième chapitre porte lui aussi sur l'homogénéïté de la dynamique des prix au sein de la zone euro, mais traite le problème de manière différente. Reprenant nos séries de prix sur la période allant de Janvier 1970 à Juillet 2011, nous testons la version absolue de l'hypothèse de la Parité des Pouvoirs d'Achat (PPA) par le biais de tests de racine unitaire et de cointégration en panel de deuxième et de troisième générations. Dans l'ensemble, la dynamique des prix apparaît hétérogène et dépendante des périodes d'évolution de l'UEM, ainsi que des groupes de pays considérés. Plus précisément, alors que la PPA est vérifiée pour les pays appartenant au coeur de l'Europe, elle n'est pas valable pour les pays périphériques du Nord. Pour les pays périphériques du Sud, elle est respectée uniquement avant le lancement de l'euro.

Le quatrième chapitre a pour objet de relier de manière formelle les déséquilibres externes à la crise de la dette souveraine que connait l'UEM depuis 2009. En nous basant sur une approche CHEER (Capital enHanced Equilibrium Exchange Rate), qui rattache le marché des biens au marché des capitaux via le taux de change anticipé, nous montrons que lorsqu'un pays appartenant à une union monétaire fait face à un déséquilibre externe vis-à-vis d'un autre pays membre, l'écart de taux d'intérêts correspondant tend à s'accroître. De plus, lorsque ces désquilibres persistent, ils peuvent déclencher une crise de la balance des paiements. Nos résultats indiquent qu'un tel phénomène semble être à l'oeuvre pour les pays européens sous assistance financière internationale.

Le dernier chapitre vise à expliquer pourquoi les pays de la zone CFA, alors qu'ils ne respectent pas les critères d'optimalité, ont réussi à maintenir leur union monétaire pendant des décennies. Nous avançons l'idée que bien que non optimale, la zone est au moins

soutenable. Nous testons cette hypothèse en nous fondant sur l'approche comportementale du taux de change d'équilibre (BEER). Après avoir étudié les processus d'ajustement vers le sentier d'équilibre de la zone CFA et d'un échantillon composé d'autres pays d'Afrique Subsaharienne, nous les comparons. Nos résultats attestent que relativement aux autres pays Subsahariens, la zone CFA a favorisé les équilibres internes et externes, et facilité les ajustements aussi bien au niveau de l'ensemble de la zone, qu'au niveau individuel.

# Chapter 1

# Monetary Unions: some general characteristics and properties

This first, introductory chapter intends to set the analytical framework on which our concerns deal with: the monetary unions. Before entering into the considerations of imbalances or sustainability, we review this field of international economics. To be complete, we start in Section 1.1 by paying interest to the essence, the reasons and the limits of currency areas, then we pursue in Section 1.2 by presenting the literature on optimality, and finally we introduce in Section 1.3 the two monetary zones under study (Eurozone and CFA franc zone) by giving some historical features and by explaining their functioning. Section 1.4 concludes the chapter.

## 1.1 Monetary Unions: definition and creation

### 1.1.1 What is a monetary union?

A monetary union is a stage of economic integration characterized by the will of several countries in relinquishing their national currency in order to adopt a new monetary etalon, common to all the countries participating in the union. It supposes the renunciation to independent monetary policies, to an independent central bank, and to a part of the seignoriage revenues. Only a supranational organism is able to deal with monetary issues. However, as Perroux (1954) emphasized, the concept of integration in economics is almost obscure. It covers different acceptations. Here we pay a special interest to the two main definitions: the neo-classical one (linked to the "formal" approach of economics) with Balassa (1961), and the regulationist one (linked to the "substantial" approach of economics) supported by Byé and Destanne De Bernis (1977).

Following Balassa (1961), economic integration is *"[...] a process and a state of affairs. Regarded as a process, it encompasses measures designed to abolish discrimination between economic units belonging to different national states; viewed as a state of affairs, it can be represented by the absence of various forms of discrimination between national economies."* Here, integration is at first a market-based integration, aiming to create a regional market, while maintaining national regulations. Only in a second time come supra-national institutions for regional regulation as a completion of integration. Thereby, if we take the typology set by Balassa (1961), we can see a monetary union as one of the final step of a total economic integration, which is divided in five "stages", ranked by croissant order of intensity.

1. The establishment of a Free Trade Area. A Free Trade Area (FTA) is an agreement between several countries that decide to abolish (gradually) tariffs and quantitative restrictions towards participating members. It aims to realize the free movement of goods and services inside the area. The trade policy towards non-participating members remains a national competence.

2. The formation of a Customs Union. A Customs Union (CU) is a FTA where the participating countries adopt a common external tariff. There is a gradual harmonization of the national trade policies towards non-participating members.

3. The implementation of a Common Market. A Common Market (CM) supposes not only the free movement of goods and services inside the area with a common external tariff, but also the free movement of the production factors (labor and capital).

4. The Economic Union. The member countries commit themselve to harmonize their national economic policies (structural and cyclical) in order to have a better economic coordination.

5. The total Economic Integration. In this final stage, politics and economics are closely linked. There are common monetary policies through the constitution of a monetary union, but there are also common fiscal and social policies. All the elements that found national sovereignty (in the economic domain) are abandoned to supranational institutions.

Byé and Destanne De Bernis (1977) have a more restricted idea of what integration is. They distinguish the internationalization of markets from the integration. The internationalization of markets is *"[...] all the decisions that aim to enlarge markets, whether sector by sector, whether generally, and improve their working by homogenizing their institutional rules, each space keeping its own regulation processes"*, whereas the integration is *"[...spaces, activities, or groups that are submitted to the same social procedures of regulation"*. According to them, integration only begins at stage four of the Balassa's classification when common policies are implemented, and supranational authorities are created (both being precisely "*steps toward the affirmation of common social procedures of regulation to the various parts gathered"*). FTAs, UDs, and Common Markets, cannot constitute integration processes since Byé and De Bernis don't consider the market as a social procedure of regulation. They are just contractual agreements intended for enjoying

the advantages of a larger market.

Even if the two acceptations of integration are different, we can say that a monetary union is one of the last steps of integration. It is a "functional union" since it is a pooling of a functional instrument, the currency.

### 1.1.2 Why create a monetary union?

Most of the experiences of integration are market oriented (even in West and Central Africa despite the colonial period which was a particular case we develop in section 1.3.2). Thus, we adopt the Balassa's approach of integration. In order to understand the reasons that lead countries to form a currency union we must first consider the first stages of integration, particularly the CUs and the CMs. As a final stage, most of the benefits of a currency union are actually a deepening of CUs and CMs gains on market efficiency.

The study of the customs unions' effects was first handled by Viner (1950). In a partial equilibrium framework, with importing goods produced under increasing marginal costs, and exporting ones produced under constant costs in each country, he points that the customs unions have not a clear-cut effect on welfare. Two kinds of effects may happen during the implementation of a CU: trade creation and trade diversion. Trade creation corresponds to the expansion of imports inside the zone due to the discriminatory tariff liberalization (De Rosa, 1998). Trade diversion occurs when the same discriminatory liberalization promotes imports from a supplier inside the zone that is not the lowest cost supplier (Baldwin and Venables, 1995). Unlike the simplistic view that a custom union is always benefic since it is a move toward a partial optimum, Viner reveals that union is only benefic in terms of welfare when trade creation outweighs trade diversion. Meade (1955) generalizes these results using a more refined framework: a general equilibrium model with constant costs of production in trading partners and an equilibrium in international payment balances. The success of the CU depends on three criteria.

- The choice of the partners. The more the partners have a similar specialization pattern, the more the union will be profitable. The idea is that countries that are complementary already have a high bilateral level of trade, and the removal of tariffs would have little impact on traded volumes. Another issue concerning the partners

is the size of the union. A large union is less trade-distorting since it approaches the situation of world liberalization (and therefore the Paretian optimum).

- The initial price differentials between the partners. The more the partners are competitive-cost producers of exportables, the less the union will be trade-distorting, and thus the more it will be welfare improving.

- The levels of tariffs between partners before the union. The more the tariffs are high before the union, the more the trade-creating effects will be important.

If a union is advantageous, we can set two types of economic effects: static and dynamic. The principal static involvements are the improvements in allocation efficiency. Eliminating tariffs between partners allows them to purchase their goods to the more efficient producer, causing a decrease in border prices. It triggers a specialization scheme that conducts to an increase of trade, consumption and production (i.e. of output). Assuming a constant rate investment, an output raise induces a higher accumulation path, and so a higher output per worker (Baldwin and Wyplosz, 2006). The principal dynamic issue is the rationalization of production (which also has an impact on allocation efficiency). Openness heightens the competition, which entails a series of firm's restructuration.

- Cost rationalization. The firms "hunt every waste". The X-inefficiency decreases and the competitiveness of the firms is improved.

- Technological progress and innovation. In order to keep or earn market shares, the firms tend to innovate in their processes (to be more productive, and at least more competitive), but also in their products (to differentiate them from other firms).

- Organizational restructuration and economies of scale. In a world composed by closed economies, markets are fragmented, prompting a lot of firms to exist under protective conditions. Openness to trade partly unifies these fragmented markets and eliminates the companies that are the less competitive. Global demand is therefore split between the remaining firms that deal with higher individual demands. In order to face it, they have to restructure their production plant (especially at the organizational level). Economies of scale come from that restructuration. By raising the quantities they supply, firms benefit from increased returns to scale: the fixed costs are better recouped, and this raise generates learning effects and a better organization of production. There is a merging movement between firms that allows them to be more efficient.

When a Common Market is achieved, free movement of factors is established. The benefits expected from a CM are miscellaneous.

- A strengthening of economic information flow. According to Byé and De Bernis (1977), a wider integrated market supplies more information, of a better quality, at a lowest cost. In a risky universe, agents' decisions are more accurate. Market efficiency is improved.

- An equalization of factor prices. Balassa (1961) observes that trade is not sufficient to completely equalize factor prices. However, this equalization is essential to ensure an optimal resources allocation. Factor liberalization is needed to fulfill prices factor equalization.

- A multinationalization of firms. As in a CU, there is a concentration of activities in order to rationalize the production. Without capital control, this concentration is worldwide. Firms can expand (part of) their activities outside national borders, or merge with foreigners.

As in customs union theory, the main benefit of free factors movement is a better efficiency of the markets. With monetary union this procedure of market efficiency enhancement is carried on. De Grauwe (2000) gives several mechanisms by which a currency union improves market efficiency.

- The direct gains of transaction costs elimination. A single currency among several countries avoids the need of changing money. The difference that an agent pays between the bid and the ask of a currency is a deadweight loss that is removed. It increases the general welfare. Note that in order to suppress all the transaction costs the payments systems have to be fully integrated.

- The indirect gains of transaction costs deletion. In a currency area, prices are immediately comparable in all the countries that form the union. The information carried by the price is fuller, that allows reducing the discrimination between national markets. Some studies evidence that national currencies play a role in market fragmentation (as Engel and Rogers, 1996). A currency union is a deepening of common market since it enables unifying markets, and then achieve a single market.

- The lowering of uncertainty (risk) of real exchange rate. Real exchange rate (RER) risk (or uncertainty) is the divergence between the evolution of the exchange rate

and the economic fundamentals, i.e. a misalignment. As De Grauwe (2000) shows for USA and the dollar appreciation between 1980 and 1985, a misalignment can foster wrong investments and cut off competitiveness. Thus the economy will face harsh adjustment costs. Shrinkage of uncertainty is able to limit these adjustment costs. Note that this RER uncertainty weakens the information provided by the price mechanism (De Grauwe, 2000), raising the systemic risk. Insofar systemic risk is higher, the real interest rate (which takes in account the default risk) increases. Further, higher interests rates lay down the problem of moral hazard and adverse selection. Thereby, a lower uncertainty of RER leads to lower real interest rates.

The monetary union is also a way to countries experiencing high inflation rates to "import" credibility from countries that have "hard-nosed" (Barro and Gordon, 1983) monetary authorities. Otherwise, these kinds of unions seem to have some effect on trade and growth. Thanks to a gravity model where bilateral trade between countries sharing the same currency is controlled by a dummy, Rose (2000) finds that a currency union has a large effect on international trade. Compared to countries having their own currency, countries belonging to monetary union trade between two to three times more. Using a meta-regression analysis (which is a quantitative literature review aiming to provide robust results from primary literature); Rose and Stanley (2005) confirm the fact that the currency unions have a robust positive impact on trade. However, the magnitude is much lower: bilateral trade raise is between 30% and 90%. Taking the basis that trade increase boosts growth, Frankel and Rose (2002) investigate the link between common currencies and income per capita in 200 countries. Their estimates establish a significant positive link between currency unions and growth through trade increase rather than non inflationary commitment. Micco et al. (2003) also find a positive link in the EMU.

### 1.1.3 The costs associated to the constitution of a monetary union

However, the constitution of a monetary union does not bring only benefits. There are also several costs that should be taken into account if we want to determine if a monetary union is beneficial or not. Joining a monetary union supposes giving up its national currency. Symbolically as economically, it implies a loss of sovereignty. Symbolically, currency has always been a mean of geographical and political national unification. Economically, currency is an instrument of political economy: it enables national government to conduct

chosen monetary and exchange rate policies. When a country belongs to a currency union, its exchange rate is fixed, and it has no independent central bank anymore: the monetary policies are conducted at the federal level. Beyond the sovereignty loss, some costs can arise from the relinquishment of national currency. Indeed, countries may not have the same economic structures, so that the "one size fits all" monetary policy of currency unions may be inappropriate.

### The loss of nominal exchange rate instrument

Under specific conditions, the use of nominal exchange rate is efficient in absorbing external and internal disequilibria. Taking back the example of Mundell (1961) of a demand shifting from a country to another, De Grauwe (2000) exhibits that, in the presence of macroeconomic disequilibria between two countries, the modification of the parity between currencies is the unique solution to restore equilibrium, avoiding unemployment and inflation, when there are price and wage rigidities, and an imperfect mobility of labor between the countries. In the country that has a current account deficit, the devaluation will allow improving the competitiveness, and conversely, in the country that has a current account surplus, a revaluation will lower the inflationary pressures it faces. These currency adjustments foster a modification of the demands addressed to the two countries. The country showing a deficit will face an increase of demand, and country showing a surplus will face a decrease. Thus unemployment will fall in the first country, and inflation will be under control in the second.

### The loss of independent monetary policy

Two major concerns can be identified about the loss of independent monetary policies: the arbitration unemployment/inflation and the seignioriage revenues. Assuming a Keynesian framework where Phillips curves are stable, De Grauwe (2000) explain that countries that have different preferences on inflation and unemployment cannot form a monetary union. Indeed, if countries choose a different inflation rate, the fixed parity induced by a currency union cannot be respected. The country that has the higher inflation rate will deal with a loss of competitiveness compared with countries that have a lower inflation. To restore competitiveness, high inflation country irremediably has to devalue its currency, breaking the union. So the cost of surrendering monetary policies lies in the shift of inflation and

unemployment preferences. This argument has been largely mitigated, since the criticisms that Friedman (1968) and Sargent and Wallace (1975) have formulated on the stability of the Phillips curve.

The seignioriage revenue (also called inflation tax) is the difference between the cost of making banknotes and their face value (that is higher), supplemented by the interests coming from the refinancing of banking system. This source of revenue is more or less used by countries in order to finance their budget deficit. Generally, this tool is used when *"marginal cost of raising revenue by increasing taxes exceeds marginal costs of raising revenue by inflation (seigniorage)"* (De Grauwe, 2000). Two problems arise with the implementation of monetary union. First are the differences between countries in marginal costs of budget financing. These differences are related to the degree of development and efficiency of tax systems. A country that experiences an underdeveloped inefficient tax system will tend to finance its debt by printing money. This expansionary monetary policy induces inflation, which depreciates the value of the money: paper money is an asset that is not indexed on inflation, so its holders experience a decrease in their net wealth, while the issuance institution increases its revenues.[1] Here again, arises the problem of inflationary preferences. In a currency union between countries which resort on seigniorage and countries which don't, some of them will have to renounce to their preferences. The second is the distribution of seigniorage revenues between countries. Since monetary issuance is centralized at the federal level, the seignorage revenues are "collected" at the federal level. It is quite difficult to determine the part of each country accounting for their weight in the monetary supply, or they need in function of the tax system efficiency.

### The differences in economic structures

Even if we consider the monetary union as the completion of the integration process, some differences between countries may remain.[2] We tackle the differences in economic structures: some features, as labor market or productivity growth may remain largely idiosyncratic.

[1] Seigniorage consists in levying a tax on paper money holders (and most generally on liquid assets holders).

[2] EMU is a fair example.

As we will see in section 1.2.1, in absence of nominal adjustments such as devaluations, adjustments have to be real. In that sense, labor belongs to those real adjustments. The constitutions and the organizations of labor markets are historically the result of several national legal events that have changed the economic and social structures.[3] Two major concerns can be highlighted when joining a monetary union: wage bargaining, and flexibility. Based on Bruno and Sachs (1985) and Calmfors and Drifill (1988), De Grauwe (2000) emphasizes that the structures of trade-unions that determine wage bargaining may introduce asymmetric responses among countries, even when a (supply) symmetric shock heats a monetary union. The idea is that when wage bargaining is fully centralized or fully decentralized, unions will hesitate to claim a higher nominal wage because in the first case, they account for the inflationary process of an higher wage, and in the second case, they account for the loss of competitiveness of the firm (and the possibly unemployment arising for this loss). Versus, when wage bargaining is partially centralized or decentralized, unions tend to request higher nominal wages, which increase misery indexes[4] (Calmfors and Drifill, 1988). So in a currency union where members have a different wage bargaining, the "one size fits all" monetary policy is not fully efficient. We can have the same argument considering flexibility. Some countries have a more flexible[5] market labor than others, thus when countries face a symmetric shock, responses may be asymmetric, making monetary policy inefficient or even distortive.

Another concern is the productivity differences. Productivity growth is directly linked with education, market labor characteristics and also capital intensity. These factors are largely dependent on structural policies but also historical legacies. Thus we can consider that despite the harmonization induced by the integration, some of these features may remain country-specific. Considering the case where there are productivity growth differences between countries[6] inside monetary union, problems of competitiveness will occur in absence of independent monetary policies and possibilities of devaluation (Blanchard, 2007).

[3] We can quote Marx (1867) and the enclosures, Polanyi (1944) and the end of the Speenhamland system.

[4] Misery indexes are indices that account for inflation and unemployment.

[5] By flexibility we mean differences in minimum wages, legislation on part-times, formation, etc.

[6] Those are not catching-up phenomena.

## 1.2 An assessment of monetary unions' efficiency: the OCA theory

### 1.2.1 The criteria of OCA's literature

The interest on Optimum Currency Areas (OCA) starts with the seminal paper of Mundell (1961), in which he challenges the view of Milton Friedman (1953) that flexible exchange rates are always efficient to absorb balance of payments disequilibria. According to Mundell, that kind of problem can only be solved if nations (countries) are the *"appropriate domain of currency area"*, i.e. are an optimum currency area. McKinnon (1963) certainly gives the more accurate definition of optimality: *"[...] Optimum is used here to describe a single currency area within which monetary-fiscal policy and flexible external exchange rate can be used to give the best resolution of three (sometime conflicting) objectives: (1) the maintenance of full employment; (2) the maintenance of balanced international payments; (3) the maintenance of a stable internal average price[...]"*. At the sight of this definition, we can refer OCA to a currency area able to ensure internal (objectives 1 and 3) and external (objective 2) equilibrium. Since Mundell, several articles have been written in order to determine under which conditions a currency area may be optimal (see references below). Afterwards, we are going to set these criteria.

#### Wage/price flexibility and mobility of labor

Mundell (1961) points out the importance of wage flexibility and/or factor (especially labor) mobility as conditions of optimality. Tacking again the example of a shift in demand within a currency union from a country to another, but relaxing the hypotheses of wage and price rigidities and imperfect mobility of factors, we can exhibit the uselessness of a nominal exchange rate change.

In the country that shows a current account deficit, if we assume wages and prices flexibility, workers will reduce their wage claims, or even accept to decrease their real wage because of unemployment. Indeed, when prices and wages are flexible, the fear of unemployment that arises from the current account deficit pressures downward the wages. Conversely, in the country with current account surplus the boom of demand will pressure the wages upward. As De Grauwe (2000) emphasizes these mechanisms lead to an equilibrating adjustment:

the reduction of wages in the deficit country causes a fall in the aggregate supply, and the expansion of wages in the surplus country will push up aggregate supply. Prices in the deficit country drop and prices in surplus country grow. Relative prices of deficit country are enhanced which reflects an improvement of the competitiveness compared to the surplus country.

Furthermore, the enhancement of competitiveness will shift demand addressed to countries from surplus country to deficit country, which strengthen the stabilization by increasing aggregate demand in the deficit country and decrease the aggregate demand in the surplus country.

If we now hypothesize the labor mobility, the stabilizing mechanism is the following: the unemployment existing in deficit country and the scarcity of labor in surplus country that comes from a shift in demand are solved by emigration. Workers from the current account deficit country will move to the current account surplus country, until unemployment and inflation pressures disappear.[7]

### The openness of countries participating in the currency union

The first author to highlight the importance of openness in the determination of optimality is McKinnon (1963). Tacking the tradables versus non-tradables ratio as a measure of openness, he shows that exchange rate is relatively inefficient in pursuing objectives 2 and 3 in small open economies. Since in an open economy, tradables have more weight than non-tradables, exchange rate fluctuations do not improve significantly competitiveness because the price of tradables is exogenously internationally determined, it just will expand internal price levels. The more likely solution is to peg the currency to those of trading partners and conduct a fiscal policy aiming to cut expenditures in order to enhance competitiveness. Thus, when a currency area is formed by interdependent open economies, and is relatively closed to the rest of the world, it is more likely to be an optimum currency area.

As Beine (1999) stresses, there are other arguments to see openness as a central criterion. If we adopt the cost-benefits analysis, the more intuitive is given by Mélitz (1991): the higher is the volume of trade within the monetary union, the greater are the benefits com-

[7]Note that a combination of wage flexibility and labor mobility leads to the same effect.

ing from transaction costs economies. He also shows that the most open economies have a higher marginal propensity to import, which yields the exchange rate less efficient for adjustments.[8]

Finally, as argued by Krugman (1990) or De Grauwe (2000), the gains coming from the uncertainty reduction (due to nominal exchange rates fixation) depend on the degree of interdependency of countries belonging to the union.

### The production (specialization) patterns

Kenen (1969) supplements the production patterns to the criteria of optimum currency areas. According to him, diversification is a main condition, since in sufficiently diversified economies, any sector is important enough to "overtake" all economy. Even when shocks occur in a specific sector, they have little effects that are largely absorbed by whole economy: given the small size of each sector, terms of trade do not have to change dramatically in order to recover balance of payments equilibriums. Hence, as Mongelli (2005) emphasizes, diversification reduces the need of nominal exchange rate changes, i.e. diversification makes exchange rate removal little costly. The basic idea behind this theory is the appliance of the insurance against macroeconomic fluctuations (Beine, 1999). Negative shocks in some sectors are expected to be balanced by positive shocks in others (Horvath, 2003). Diversification offsets the international labor immobility by allowing an inter-sectoral mobility (Beine, 1999).

### The similarity between inflation rates

A main topic tackled by Fleming (1971) regarding currency areas is the problem of relative costs disequilibria, i.e. inflation differentials, between partners. Indeed, since the exchange rates are irrevocably fixed inside the union, inflation differentials that are not offset by productivity gains automatically entail the competitiveness of the countries facing inflation rates higher than the union average. The worsening of the terms-of-trade coming from the raise of costs results in shifts in demand similar to that of the Mundell's model. There will be external disequilibria that can be absorbed only by real adjustments, that is to say by price and wage flexibility, or/and labor mobility. So, according to Fleming, the

[8] Here, we are back on McKinnon's view.

prerequisite to constitute a monetary union is the similarity between inflation rates, which is determined by national institutional features such as similarity in national employment goals, similarity in rates of productivity, or similarity in the degree of trade union aggressiveness. When inflation rates diverge, exchange rate may be an effective instrument able to reestablish competitiveness; it will then be costly to relinquish it.

### The degree of asymmetry of shocks

In line with the arguments of Mundell (1961), McKinnon (1963) and Kenen (1969), there is an implicit OCA criterion: the degree of shock asymmetry between country members. Indeed, if shocks are symmetric between participants, fixing irrevocably exchange rates will have no cost because flexible exchange rates in this case are inefficient.

Researches on the symmetry of shocks back to Vaubel (1976), but they concentrate on the period of EMU launching in the 1990's. As stressed by Beine (1999), shocks are by definition unobservable that is why this strand of OCA literature is exclusively empirical.[9] Several approaches have been adopted which the main are: i) the comparison of exchange rates variability (Eichengreen, 1990, or Von Hagen and Neumann, 1994), ii) the measurement of business cycles and shocks asymmetry thanks to VAR models (Bayoumi and Eichengreen, 1993), and iii) the cluster analysis (Bénassy-Quéré and Coupet, 2005). The first one compares the volatility of the bilateral real exchange rates in the studied area to the volatility of a well-established currency union. The underlying idea is that asymmetric shocks will induce a higher volatility. The second approach is undeniably the most popular. It consists of applying the VAR decomposition of Blanchard and Quah (1989), in order to transform the VAR residuals in supply and demand shocks, and hence compare correlation of these shocks. Finally, the cluster analysis defined by Bénassy-Quéré and Coupet (2005) as *"a numerical method for sequentially aggregating objects according to some metric"* allows measuring the similarity (symmetry) between countries.

[9] A wide literature has been carried on EMU. Here we only pay attention to what has been done on the CFA zone. For a review of literature on EMU, see Beine (1999).

**Fiscal federalism**

As an essential criterion for OCA, fiscal federalism does not achieve unanimity. The first to advance arguments in favor of fiscal federalism are Kenen (1969) and Fleming (1971). They highlight the stabilizing role of a federal budget in a monetary union: when part of the union faces an asymmetric shock, regional transfers can mitigate the negative effects of the shock. Thanks to the centralization of the budget, the region in trouble pays less taxes to the federal government (stabilization) and benefits from transfers (redistribution) from the rest of the union if there is a federal social security. If we look back at the Mundell's model, the shift in demand can be solved since income increases in the region facing the adverse shock, and income decreases in the region overheating. However, and that is the reason why fiscal federalism is contested, it can be a solution only in the presence of a temporary (cyclical) shock (Fleming, 1971, and De Grauwe, 2000). When the shock hitting a part of the area is permanent (structural), fiscal transfers can alleviate the region in trouble, but real adjustments, as real wage decreases or labor mobility are necessary. Otherwise, in currency areas those have little political integration and where there are few economic leading countries, the redistribution function of the federal budget may be hardly contested by some countries.

The studies dealing with the stabilizing/transfer effect of fiscal federalism were mainly implemented on long-lived currency areas such the US or Canada. Kletzer and Von Hagen (2000) summarize the main results of literature: they are quite heterogeneous but they evidence that Canada exhibits a greater transfer function, while the US a greater stabilizing function.

### 1.2.2 The reassessment of OCA literature

Largely influenced by the Keynesian framework, the "pioneering" literature on OCA goes under reassessment during the 1980's and the 1990's. This new strand of literature aims to introduce the contributions brought to macroeconomic theory during the 1970's and to international economy at the latter 1980's. Thus "new" OCA theory incorporates topics as expectation formation, time-inconsistency and credibility, but also dynamics of specialization patterns in line with the new geographic economy. On one hand, effectiveness of monetary instruments such as monetary policy, exchange rate devaluations are challenged,

and on the other hand the consequences of the monetary union are taken into account to determine the localization of firms among partners of union.

### The effectiveness of monetary policy and the long-run Phillips curve

One of the explicit assumptions of the pioneering OCA literature is the stability of the Phillips curve, enabling monetary policy to be always effective. Friedman (1968) is one of the first to counter that view arguing that: i) economic agents think in terms of real wages (and not in terms of nominal wages such as in the Keynesian theory) which leads them to anticipate the inflation coming from expansionary monetary policies by claiming wage increases, and ii) that there is a Natural Unemployment Rate (which is structural unemployment coming from market imperfections) that cannot be halted by cyclical monetary policies. Traditional Phillips curve is transformed to take into account anticipations, which gives the augmented Phillips-curve (1.1):

$$U = U_n + a(\pi^e - \pi) \tag{1.1}$$

where $U$ is the unemployment rate, $U_n$ is the natural unemployment rate, $\pi^e$ is the expected and $\pi$ the observed inflation rates. Friedman uses adaptative expectations: agents form their forecast on the basis of past inflation and past forecast errors. It allows systematic errors in the anticipations but they decrease over time. On the short run, there is a trade-off between unemployment and inflation, but as highlighted by Tavlas (1993), that is not permanent. Phillips curves shifts upward over time becoming a vertical line on the long run at the level of the natural rate of unemployment. Applied to the OCA literature, the findings of Friedman imply that relinquishing its own currency is little costly in terms of loss of independent monetary policy since the latter is only effective on the short run.

Sargent and Wallace (1975) reach a more radical result, the full neutrality of money and the principle of invariance. Based on the model of Lucas (1972) and on the hypothesis of rational expectations (Muth, 1961), they support that the Phillips curve is vertical both in short and long run: monetary policy is totally inefficient.

### The effectiveness of the exchange rate instrument

Effectiveness of nominal exchange rate changes is also questioned by the new strand of OCA literature. As Tavlas (1993) emphasizes, the pioneering strand compares the degree of real adjustments (labor mobility, and prices/wages flexibility) against the effectiveness of exchange rates (under definite conditions such as the degree of openness) to balance external accounts. Based on a flow model, their findings are that exchange rate is an effective instrument: by improving competitiveness (even temporarily) devaluations are able to restore quickly external disequilibria. Likewise it will be costly to forsake it.

New OCA literature that drops the flow model in favor of portfolio or sunk costs reaches different conclusions. Tacking back the portfolio model, Tavlas (1993) exhibits that exchange rates can durably move away from fundamentals. A sustained current account deficit has an impact on the exchange rates to the extent that there is a transfer of wealth (from deficit to surplus countries) by the channel of risk premium. In the absence of perfect foresights, this can lead to speculative bubbles, preventing the exchange rate to correct external disequilibria. Krugman (1991) puts forward, thanks to a sunk-cost model, that exchange rates changes can launch external adjustments but only at a long lagged horizon. When firms are in oligopolistic concurrence, they adopt a strategic behavior, reasoning on long rather than on short run. By doing so, it can be gainful for exporter firms to do not change their specialization patterns or their prices at each exchange rate changes even if they sell at a loss; if they think that this change is transitory. Such a process also dampens the effectiveness of exchange rate devaluations.

However, exchange rates cannot be thrown to the dogs. Even if the improvement of competitiveness following a devaluation disappears over time (De Grauwe, 2000), some empirical examples of devaluation certify of the effectiveness of exchange rate. One of them is the devaluation of the CFA franc in 1994.[10] Djoufelkit (2007), basing her study on the real effective exchange rates provided by the *Agence Française de Développement* (AFD) argues that in 2006, twelve years after the devaluation, and despite the differences between WAEMU and CAEMC, the CFA franc maintained 17.5% of the gains retrieved from the devaluation.

[10] There are also the cases of Belgium in 1982 (De Grauwe, 2000), France in 1982/83 (Sachs and Wyplosz, 1986), or Danemark in 1982 (De Grauwe and Vanhaverbeke, 1990).

### Time-inconsistency and credibility issues

As in the former strand of OCA literature, inflation is still a main topic of reassessment. Since "old" OCA considers there is a trade-off between inflation and unemployment, inflation is seen as a lesser evil that allows boosting economic activity. The only condition is, when forming a monetary union, to have similar inflation rates between partners in order to avoid a loss of competitiveness and possible asymmetric shocks. "New" OCA integers the findings of Monetarism and of New Classical Economy showing that there is no trade-off in the long (and even in the short[11]) run. Inflation has no benefits, only drawbacks remain: inflation tax, allocation of resources bias, and a loss in the store of value function. It conducts its proponents to reverse the causality between inflation and the desirability of monetary union (Tavlas, 1993): currency union may be a fair strategy to reach low inflation levels, at lesser costs than it would be if a disinflation policy is implemented, because of problems of time inconsistency and credibility.

The analysis starts with the article of Barro and Gordon (1983), supporting that private agents adopt strategic behaviors face the decisions (and the policies) taken by public authorities. Their model, based on the augmented Phillips curve set in (1.1) and supplemented by rational expectations, shows that public authorities face a problem of time consistency: they face a dilemma between short and long run. On the short run, governments can lower the unemployment below the Natural Rate of Unemployment by taking private agents by surprise. Indeed there is a trade-off between unexpected inflation and unemployment. However, on the long run this trade-off disappears because of rational expectations. Private agents forecast inflation rates on the basis of all the past and present available information, so if public authorities tend to ignore their commitments in respect with inflation targets, private agents take it into account. They integrate that government suffers from a lack of credibility, raising their anticipated inflation rates to the point that public authorities have no incentive to break its commitments in matter of inflation targets.

The conclusions of the model have been employed to challenge the view of Fleming. In countries with relatively high inflation track-record or that often rely on devaluation, expected inflation rates are very high, and credibility of authorities is severely dampened. In such a case, reestablish confidence in order to decrease inflation can take a while, generating high disinflation costs. An alternative can be joining or forming a monetary union

[11] Note that this issue is still disputed.

with countries experiencing low inflation rates. It allows to "import" credibility, since high inflation country "ties its hands" by relinquishing independent monetary policy. By this way, credibility is thought to be recovered more quickly which reduces the cost of disinflation.

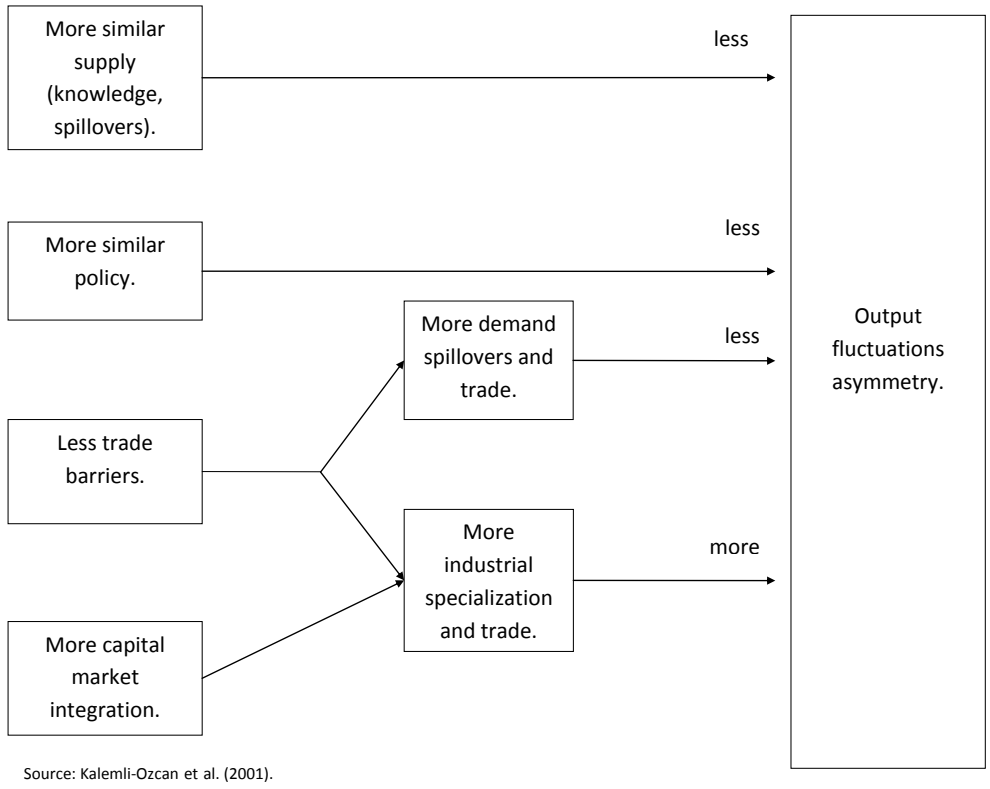
### Dynamics of currency unions: specialization versus endogeneity

Since the beginning of OCA literature, emphasis is placed on i) the nature of shocks, and ii) the response of currency area members to these shocks. In other words, the main topics concern the economic patterns of members, and the adjustment degree existing between them. When shock affects members in a symmetric way (i.e. economic patterns of members are identical) then, a currency area is optimal. When shocks are asymmetric (i.e. economic structures and patterns are heterogeneous), the currency area will be optimal only if there is enough adjustments inside the zone able to solve disequilibria. This view is largely static because it implicitly assumes that monetary unification has any impact on economic specialization. Recent OCA seeks to tackle this shortcoming by surveying the economic dynamics of integration. There is no study specifically dedicated to currency union effects. Literature rather deals with economic integration outlets, considering currency union as the highest level of economic integration. The various effects on output fluctuation symmetry and the channel by which they proceed are identified by Kalemli-Ozcan et al. (2001) in Figure 1.1.

As we can see, some channels conduct to less asymmetry in output fluctuations, and others to more asymmetry. There are two conflicting opinions since it is empirically unknown what channel dominates.

On one hand, Krugman (1993) and Kalemli-Ozcan et al. (2001) support that integration leads to asymmetry in output fluctuations. According to Krugman, monetary unification influences localization of firms since trade barriers are lowered. In order to benefit from economies of scale, firms tend to concentrate their activities in some regions, which increase the specialization of each member of the union. It induces instability of regional exports because members are very sensitive to shift in tastes and technology, pro-cyclical movements of capital, and a divergence in long run growth (Krugman, 1993). In brief, currency unification fosters high specialization of each member, allowing that sector-specific shocks

Figure 1.1: **Effects of economic integration on fluctuations' asymmetry**




become country specific shocks. For Kalemli-Ozcan et al. (2001), the reasons why countries specialize are quite different. When countries have their own currency, they diversify their production in order to avoid the risk of high fluctuations in outcomes resulting from sectorial shocks. One of the benefits of monetary unification is the constitution of an integrated financial market between members. Countries are able to diversify the assets held and so their outcomes. Such a diversification amounts to insure outcomes against sectorial shocks, allowing countries to highly specialize their production in the sectors they present a comparative advantage. It thus comes that this specialization generates asymmetry in output fluctuations between members of a same currency union.

One the other hand, some authors focus on the endogeneity of OCA. Frankel and Rose (1998) put forward that monetary unification may allow achieving optimality for a group of countries that did not respect the criteria *ex-ante*. Even if their conclusions are opposite to those of Krugman (1993), their analysis also relies on the removal of trade barriers. It is thought that these removals increase trade flows, what in turns raise the dependence

between countries through the trade channel: the pass-through of economic fluctuations between members is higher, which tends to enhance the degree of symmetry in fluctuations.

Fontagné and Freudenberg (2002) try to explain this ambivalence of trade by differentiating the intra-industry trade inside the EMU. Two types of intra-industry trade can be set: a "two-way trade in variety" (when products are differentiated horizontally), and a "two-way trade in quality" (when products are differentiated vertically). If trade in varieties induces a diversification of economies, trade in quality behaves as inter-industry trade. Since it is based on specific endowments (as specific factors, research and development or labor skills), a specialization may occur, increasing the asymmetry of economic patterns between members of a currency union. Thus endogeneity or specialization depends on the type of intra-industry trade inside the union.

## 1.3 Presentation of the two monetary unions under study

### 1.3.1 The Economic and Monetary Union

The European integration is a long-lived process that started after World War II. Usually, its beginning is set to the year 1952 and the creation of the the European Coal and Steel Community (ESCS), even if premises can be found in the cooperation organisms (as the Oragnization for European Economic Cooperation, OEEC, in 1948, or the European Payments Union, EPU in 1950) formed by the former belligerents in order to administer the economic assistance provided by the Marshall Plan.

#### Towards a Common Market

The ESCS, that gathered six countries (Belgium, France, Italy, Luxembourg, the Netherlands and West-Germany) aimed at promoting a free trade in the sectors of coal, iron ore and steel by removing tariffs, quotas, and discriminatory behaviors. Moreover, ESCS was not a simple FTA since there was a common external tariff for these products. Hence, it can be seen as the first European Customs Union. As put forward by Montiel (2009), large economies of scale were expected from this agreement which allowed to fuel the reconstruction of the industrial sector of participants.

The second step of integration took place in 1957 with the Treaty of Rome that established the European Economic Community (EEC) in 1958 among the same members belonging to ESCS. The goals of this union were manifold. It intended to extend the ESCS by generating an European Common Market ensuring the free trade of all goods and services and the free movement of production factors (labor and capital). Furthermore, it also sought to reinforce the bargaining power of European countries in the international rounds on tariffs by constituting an economically unified powerful zone. Finally, there were also concerns that went beyond a simple market integration since EEC was also interested in common economic policies.

Regarding the Common Market aspects, quotas are retrieved in 1962 for industrial goods and 1968 for agricultural products, internal tariffs are lowered by steps until their full elimination in 1968,[12] and a common external tariff is adopted in the same year. However European labor markets continued to be partitioned and capital controls persisted. At the political plan, a Common Agricultural Policy (CAP) is implemented in 1961. It aspired to increase the productivity of European Agriculture, and insure decent agricultural incomes. To this end, in addition to the free trade of agricultural products, it supported the agricultural prices by subsidizing the European producers. Since the 1980s, this agricultural policy has experienced several reforms due to the surpluses it has encouraged, and to the liberalization of agricultural products initiated by the Doha round since 2002. In 1973, there has been an enlargement of the EEC to Denmark, Ireland and the UK. In 1981, Greece joined EEC, followed by Portugal and Spain in 1986.

Several reports during the early 1980s (among which the most famous is the white paper of 1985) pointed some failures in the Common Market achievement. It decided European Commission to enforce the Single European Market Act in 1987. This last was supposed to end with "*the costs of the Non-Europe*" (Cecchini report, 1988), by pulling down the remaining trade barriers (as the sanitary and technical standards) in goods and services, and unifying the capital market by withdrawing the exchange control and the administrative authorizations needed to settle banking or financial business. Moreover, to facilitate the labor mobility, the Schengen Convention is signed in 1985 between Belgium, France, Luxembourg, the Netherlands and West-Germany.

[12]Note that safeguards authorizing the adjournment of these agreements in case of severe commercial troubles.

### The early monetary agreements

If the first monetary agreement in Europe was the forgotten EPU of 1950, the European monetary construction actually began in 1971 with the Werner plan that instituted the European Monetary Snake in 1972 between the EEC members, whose management was committed to the European Monetary Cooperation Fund (EMCF). These agreements aimed to reduce the large fluctuations allowed by the Smithsonian Institute Agreements (±2.25% to ±1.25% ), because they was thought to be incompatible with economic integration. According to Montiel (2009), three objectives were pursued: i)the boost of intra-European trade thanks to the suppression of exchange rate uncertainty, ii) the strenghtening of Europe's position in international monetary system, and iii) a cost reduction of the CAP's price support. Nevertheless, the first oil shock led the participants to float *vis-à-vis* the US dollar, conducting the "Snake" to go out of the "tunnel".

Despite the failure of the Snake, a new monetary framework was implemented in 1979 between EEC members except the UK: the European Monetary System (EMS). This multilateral system of fixed (but adjustable) exchange rates (Montiel, 2009) were organized around the European Currency Unit (ECU) and the parity grid that constituted the Exchange Rate Mechanism (ERM). The ECU was a basket of members' currencies weighted by the relative economic importance of each member, while the parity grid defined the central rate toward each currency could fluctuate within a band of ±2.25% (±6% for Italy). As for the Snake, the operation of the EMS rested on the EMCF. Each participant had to deposit 20% of its gold and currency reserves to EMCS in return of ECUs.[13] If parities were adjustable, they could not be altered unilateraly: a consensus among EEC members and the Council of Ministers had to be found. Relative to the fluctuation margins, a cooperation system of Central Banks was fullfiled to defend central parities, even if in fact the defense of bilateral parities was assured only by the weak-currency authorities within the band, and by both weak and hard currency authorities outside the margins (Montiel, 2009). Three new countries joined the system: Spain in 1989, the UK in 1990, and Portugal in 1992.

One of the purposes of EMS was to reap the benefits that hard pegs are able to bring:

[13]Note that official ECUs could not be used to interviene in the exchange markets.

namely, the monetary discipline or the improvement of credibility. If it ensured some stability and allowed to avoid speculative attacks, the end of capital controls, together with its asymmetric essence and its lack of credibility brought the EMS down in the early 1990s (De Grauwe, 2000). Germany actually was the leader of EMS, forcing the other countries to encompass lonely the burden of adjustment, which in turn mitigated the credibility of the monetary agreements. In 1992 and 1993, the lira, the peseta, the franc and the sterling were attacked. Regarding Italy and Spain, the reason of the mistrust lay in the inflation differentials relative to Germany (De Grauwe, 2000). Despite the efforts made in terms of convergence relative to the latter there was still a gap that cut off the competitiveness of these two nations. For France and the UK it was rather a problem of credibility (De Grauwe, 2000). The high unemployment rates and the severe recession raised doubts on the ability of these countries to pursue the same restrictive monetary policy as Germany. On the $2^{nd}$ August, fluctuation bands were set to $\pm 15\%$. Formally, EMS ended in 1998 with the creation of EMU.

### The Economic and Monetary Union

Even if the idea of a single monetary area was already present in the Werner plan, it began to materialize twenty years latter with the Delors Report (1989). The completion of the Single Market and the end of the capital controls favored the speculative attacks against European currencies in the context of soft pegs with possible realignments (as we evidenced above). A solution was to advance with a more binging commitment, in other words, a monetary unification. The Delors' Report set the terms of unification throughout three stages (Montiel, 2009):

1. Establish an EMS composed by all the EEC currencies where operating rules are homogenized.

2. Define the tolerable levels of budget deficits for the countries willing to enter the EMU, and the create a European System of Central Banks (ESCB) that gathers the Central Bank participants and that stands for an embryo of a Federal Central Bank.

3. Adopt an irrevocably fixed exchange rate in order to further design a common single currency.

The Delors' Report, adopted in 1989 in Madrid, brought to live the Maastricht Treaty (1991) that is ratified by EEC members in 1993. This treaty carried out the second and

the third stages of the Delors' Report and transformed EEC into the European Union (EU). During the second stage, a European issuing institution is built in 1994: the European Monetary Institute had its headquarters in Frankfurt and was the precursor of the European Central Bank. According to De Grauwe (2000), its role was limited and the main function was the enhancement of monetary cooperation between central banks. In 1995, there were another enlargement of EU with the joining of Austria, Finland and Sweden. Moreover, Maastricht Treaty defined defined the convergence criteria ("Maastricht criteria") needed to belong to the EMU (third stage):

- The price stability. Inflation rate for a member should not exceed 1.5 percent points the average of the three lowest inflation countries of EMU.
- The interest rate convergence. Long-run interest rates of a member should not exceed more than 2 percent those of the three lowest inflation countries of EMU.
- The exchange rate stability. The currency of a member should not have experienced a realignment during two years.
- The budgetary convergence. Public deficits should not outweigh 3 percent of GDP, and public debt 60 percent of GDP.

In 1998, the countries observing these criteria and qualified to belong to euro at the $1^{st}$ January 1999 are announced: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands an Spain formed the Eurozone, and the EMI became the European Central Bank (ECB). Despite fulfilling the criteria, Denmark, Sweden and the UK decided to not take part to the single currency. Finally Greece, it joined in 2001, Cyprus and Malta in 2008, Slovakia in 2009, and Estonia in 2011.

### 1.3.2 The currency unions in French-speaking Africa

Two monetary unions can be identified in French-speaking Africa: the UEMOA[14] *(Union Economique et Monétaire Ouest Africaine*) in West Africa, and the CEMAC[15] (*Communauté économique et Monétaire d'Afrique du Centre*) in Central Africa.[16] These two unions

[14]In English, WAEMU: West African Economic and Monetary Union. It is composed by Senegal, Mali, Burkina Faso, Niger, Guinea Bissau, Cote d'Ivoire, Togo and Benin.

[15]In English, CAEMC: Central African Economic and Monetary Community. It is composed by Chad, Central African Republic, Equatorial Guinea, Cameroon, Congo Brazzaville, and Gabon.

[16]For an exhaustive view of macroeconomic aspects in WAEMU, see Dufrénot et al. (2007) and Dufrénot and Sakho (2008).

share the same currency, the CFA franc, that is pegged to Euro[17], but that is differentiated depending on its area issuance. The CFA franc of WAEMU is not directly convertible in the CFA franc of CAEMC. To convert CFA francs from one area to another, one must go through the Euro. At first glance, this organization seems quite unrealistic, all the more that these two currency unions belong to a wider currency union: the Franc Zone. We are going to show i) how these unions have been formed, and ii) why we can consider WAEMU and CAEMC as a single currency area.

The agreements that prevail today are the results of History and of the political links that France conserved with its former colonies. Here, we begin by reviewing the construction of the monetary unions from 1945 to 1994.

### The colonial period (1945-1958)

The CFA franc is created in 1945, during the Bretton Woods agreements, as the same time of the *Zone Franc*, a currency union regrouping the French franc, the CFA (which stands for *Colonies Françaises d'Afrique*) franc, and the CFP (which stands for *Colonies Françaises du Pacifique*) franc. World War II undermined the special economic links between Metropolitan France and its colonies. The implementation of that currency union aimed to recover the links that prevailed before 1940 (Banque de France, 2002). The parity is fixed in 1948 at 0.5 CFA per French franc, and up to 1955, a single central bank for overseas territories (Hadjmichael and Galy, 1997), the CCFOM (*Caisse Centrale de la France d'Outre-Mer*) manages the CFA franc in AOF (*Afrique Occidentale Française*), in AEF (*Afrique Equatoriale Française*), in Togo and in Cameroon.[18] In 1955, two issuance boards are created: one in West Africa, the *Institut d'Emission de l'Afrique Occidentale Française et du Togo*, the other in Central Africa, the *Institut d'Emission de l'Afrique Equatoriale Française et du Cameroun.* At that time, the Zone Franc is characterized by a centralized working, a single exchange control, a pooling of exchange reserves, and a free convertibility, at fixed parities, of the currencies belonging to the union (Banque de France, 2002).

[17] At the parity of 655.956 CFA per Euro.

[18] Togo and Cameroon had a particular statute. They were not French colonies, but former German protectorates under French trust.

### The period of transition (1958-1962)

From 1958 until 1962, there are some political changes that allow colonies to access to independence. The political troubles in Metropolitan France lead to a new Constitution in 1958 that establishes a federal union, the *Communauté Française d'Afrique*, in which African colonies gain some autonomy. With the introduction of the Nouveau franc, and this federal union, the CFA denomination switches into *Communauté Française d'Afrique,* and the parity is modified to 50 CFA per French franc. The federal union is short lived, and most of the colonies gain independence in 1960.[19]

Despite the independences, the currency union of *Zone Franc* does not break.[20] Instead, the agreements are reinforced by the creation of two central banks that have their headquarters in Paris in 1959: the BCEAO (*Banque Centrale des Etats de l'Afrique de l'Ouest)* for the countries of Western Africa[21] that replaces the *Institut d'Emission de l'Afrique Occidentale Française et du Togo* and the BCEAEC (*Banque Centrale des Etats de l'Afrique Equatoriale et du Cameroun*) for the countries of Central Africa[22] that replaces the *Institut d'Emission de l'Afrique Equatoriale Française et du Cameroun.* The convertibility of the CFA is guaranteed by the French Treasury, but monetary signs emitted by each central bank are legal tenders only in the issuance zone: the CFA now means *Communauté Financière de l'Afrique* in West Africa, and *Coopération Financière en Afrique centrale* in Central Africa. France keeps the leadership of these central banks since only one third of the executive boards are delegates from the territories where CFA franc is legal tender. Moreover, these agreements ratify the monetary and economic "separation" between West and Central Africa. From that time, two distinct regional integrations are implemented in the former French African colonies.

In 1962, the countries of BCEAO form a currency union, the UMOA[23] (*Union Monétaire Ouest Africaine*). This union aims to harmonize the rules of monetary issuance, to centralize the exchanges reserves, and to ensure the free circulation of currency signs inside the area (Banque de France, 2002).

[19]Except the Republic of Guinea which declared his independence in 1958.
[20]Except the Republic of Guinea who left the agreements in 1958, the Mali who left in 1962 but returned to in 1984, and the Mauritania that left in 1973.
[21]Those are: Senegal, Mali, Benin, Togo, Burkina-Faso, Côte d'Ivoire and Niger.
[22]Those are: Cameroun, Gabon, Central African Republic, Congo Brazzaville and Chad.
[23]WAMU in English: West African Monetary Union.

In 1962, a customs union is achieved between Chad, Central African Republic, Gabon and Congo Brazzaville and Cameroon.

**After the independencies (1962-1994)**

The integration process wears on in Central Africa, with the creation in 1964 of a customs and economic union, the UDEAC (*Union Douanière et Economique de l'Afrique Centrale*). It follows the purposes of protecting home industries, harmonizing the measures of industries promotion and allocating optimally the investments (Byé and De Bernis, 1977). In 1968, Chad leaves the UDEAC following conflicts with the other states. This union will persist until 1994, but it fails in completing its objectives.

In 1972 and 1973, bilateral agreements on monetary and financial cooperation are renewed between France and the members of BCEAO on one hand, and members of BCEAC on the other hand. They replace the former agreements in the sense of a higher independence of African countries. The composition of the executive boards is modified: each country has now a delegate, but decisions are taken at unanimity. Furthermore, the skills of the executive boards are extended, especially in credit distribution (Banque de France, 2002). Finally, the headquarters of de BCEAO and the BCEAEC (which becomes the BEAC: *Banque des Etats d'Afrique du Centre*) are respectively moved to Dakar in 1978 and to Yaoundé in 1977. The Equatorial Guinea enters in the BEAC in 1985.

For Hadjimichael and Galy (1997), the CFA zone has outperformed the other sub-Saharan countries between 1950 and mid-1980s. It has experienced a stronger real GDP growth and a lower inflation. However, from 1983, the worsening of terms of trade, the appreciation of real effective exchange rate (due to the raise of French franc to which CFA is pegged) and the uncontrolled borrowing of Sates from central banks have triggered a competitiveness loss that has led to large current account imbalances. In 1994, the CFA franc is devaluated by 50% (1 CFA franc = 0.01 French Franc) and structural reforms are implemented in order to clean up public accounts and recover competitiveness.

As Hadjimichael and Galy (1997) note, "[...] *the degree of economic and financial integration and of regional cooperation among member countries of the CFA franc zone had*

*remained fairly limited until 1994"*. One of the reforms that are conducted since 1994 is the relaunch of regional integration. In West Africa, the WAMU is replaced by the WAEMU[24] in 1994. This economic and monetary union seeks to fulfill the monetary union instituted by the WAMU. Its roots are based on five main purposes that are (Traité de l'Union Economique et Monétaire Ouest Africaine, article 4, 1994):

- Strengthen the competitiveness of economic and financial activities of the member States in an open and competitive market framework.
- Ensure the convergence of economic performance and of economic policies of the member states by implementing a multilateral surveillance.
- Create a common market between member States based on the free movement of persons, goods, services, capital, and the right of settlement for self-employed or employed persons, as well as a common external tariff and a common trade policy.
- Institute a coordination of national sectorial policies, by the implementation of common actions and possibly common policies in the following areas: human resources, land use, transportation and communication, environment, agriculture, energy, industry and mining.
- Harmonize State-members legislation, and especially tax system, in order to ensure a fair working of common market.

In Central Africa, an economic and monetary agreement has also been concluded in 1994: the CAEMC. It is subdivided in an economic agreement, the EUAC[25], and a monetary agreement, the MUCA.[26] The EUAC replaces the UDEAC which wasn't effective anymore, and try to give more consistency to customs union by (Banque de France, 2002):

- Implementing new rules on the common external tariff.
- Creating a preferential tariff to the products of CFA zone.
- Simplifying and harmonizing the indirect taxes inside the union.
- Creating a new tax on the turnover.

[24]In 1997, Guinea Bissau joined the CFA zone and the WAEMU.
[25]Economic Union of Central Africa.
[26]Monetary Union of Central Africa.

The MUCA establishes a monetary union which did not legaly exist, despite the fact that the countries belonging to it shared the same currency, which was managed by a common central bank since the independencies.[27]

Regional integration in West and Central Africa intends to be a mean of economic convergence. Promoting the integration of markets and the convergence of macroeconomic policies ought to improve the coherence of these economic blocks, fostering economic growth under a currency union. The fact that the regional blocks grow separately and that the two CFA francs are not directly convertible may suggest that we cannot consider the CFA zone as a real single monetary area and lesser as a real monetary union. We challenge that point of view. According to us, the institutional commitments of the Zone Franc (which defines the legal framework of the CFA franc) attest the monetary uniqueness of the CFA zone. In order to belong to CFA, the WAEMU and the CAEMC have to respect key operating principles (Hadjmichael and Galy, 1997). Furthermore, we should not forget that France has a say on the monetary policies conducted by the central banks. We first take a look at the key operating principles. They exist since the beginning of the Zone Franc, and they state that (Hadjmichael and Galy, 1997, and Banque de France, 2002):

- The convertibility of the different currencies belonging to the Zone Franc is unlimited, and is totally granted by the French Treasury.
- The parity is fixed at 655,957 CFA francs per euro. The CFA issued in different monetary unions are not directly convertible, but they are directly convertible in euros whose can be converted in CFA francs (without amounts limitation). The parity can only be modified unanimously.
- The capital transfers are free inside the Zone Franc.[28]
- The exchange reserves must be centralized in the central banks of each area issuance of the Zone Franc (this is the counterpart of the unlimited convertibility of CFA franc by French Treasury). More, each African central bank is required to deposit 65% of its exchanges reserves to the French Treasury in an operating account.

The main device to implement these former principles is operating account. BCEAO and BEAC each have a current account held with French Treasury (the operating account).

[27] Equatorial Guinea is an exception since it joined the CFA franc in 1985.

[28] In fact since the two CFA francs are not directly convertible; the free capital movement exists only between France and each issuance area.

This account is interest-bearing, and can have an unlimited negative balance. It is through this scriptural line that France guarantees the CFA convertibility. Actually, there is a backup system preventing negative balances: "*when the ratio between net foreign assets and sight liabilities of each central bank (that are BCEAO and BEAC) remained lower than 20% during three months, the executive board of the concerned central banks meets in order to take adequate policy measures*" (Banque de France, 2002). Finally, France has also a decisional power in the CFA zone since it has a delegate in the executive boards of the BCEAO and the BEAC. There also are formal meetings between Ministers of Finance of each Franc Zone members twice a year and France provide a technical support to the African central banks.

If we can adopt the view of Hadjmichael and Galy (1997), that the Zone Franc is rather a budgetary arrangement than a monetary union since the convertibility is not ensured by the ECB, but by the French Treasury, the CFA zone can be considered for its part as a monetary union. Despite the fact of the non direct convertibility between the two CFA francs, the existence of two distinct central banks, and two regional unions, the CFA zone has to obey to the agreements that tie her to the Franc Zone. If the management of the currency can be, on the short run, divergent between these two African regions, on the long run the commitments they signed force them to have the same monetary policies, and the same development pattern. As such, the devaluation of 1994 is very explicit. On one hand, the two unions suffered from an overvaluation of the CFA franc, on the other hand, the reforms that have been implemented, whether based on own choice, or whether they come from IMF and France, are the same.

## 1.4 Conclusion

If a monetary union is expected to entail several economic benefits, such as the reduction of exchange rate uncertainty, or the elimination of transaction costs that are thought to boost trade, it may also generate costs mainly due to the monetary instrument relinquishing (exchange rate, interest rates or seignoriage). In order to be optimal (when the benefits outweigh the costs), the early economic theory on currency areas demonstrated that a set of criteria have to be respected. One of the most important, and that has been selected by EMU in the Pact of Stability and Growth, seems to be the homogeneity of price dynamics,

as evidenced by Fleming (1971). In the next chapter, we tackle this topic by testing the price convergence between the countries of the Eurozone and Germany.

# Chapter 2

# On price convergence in Eurozone[1]

[1] Note: A first version of this chapter has been published as Guerreiro, D. and V. Mignon (2012), "On price convergence in Eurozone", Document de travail EconomiX 2011-34, Université Paris Ouest, Nanterre.

## 2.1 Introduction

One controversial criterion to enter the EMU is the convergence of inflation rates, which is based on the similarity of inflation rates rather than on a convergence in price levels. After the efforts made in 1996-1997 to reach EMU criteria, inflation rates have diverged within the Euro area.

Though part of it may be explained by the Balassa-Samuelson effect, this divergence has involved significant real interest rate differentials within the zone; some countries experiencing negative real interest rates that have encouraged debt bubbles. Fleming (1971) was the first to highlight the importance of price level convergence between members of a monetary union under the Optimum Currency Areas' theory. According to him, the main optimality criterion rests in the similarity of inflation rates between members: spreads of relative costs that are not offset by productivity gains lead immediately to a loss in competitiveness *via* a deterioration in terms of trade. In turn, this leads to a demand reallocation from "high inflation" countries to "low inflation" ones, generating external disequilibria between economies (deficits for high inflation countries and surpluses for low inflation countries). This risk did materialized in the Euro area between 1999 and 2009, with a number of higher inflation countries undergoing internal imbalances (excess leverage, asset price bubbles) and external deficits. After the sovereign debt crisis of 2009-2011, the question is whether these countries will manage in adjusting their price levels without the help of a nominal exchange rate devaluation, and how long this is going to take.

The literature dealing with price convergence primarily relies on the empirical verification of the Law Of One Price (LOOP) or the Purchasing Power Parity (PPP). Four main approaches can be distinguished. The first one tries to circumvent the problems inherent to incomplete microeconomic panels by focusing on a specific market. Goldberg and Verboven (2005) pay a special interest to the price dispersion on the car market in five European countries (Germany, Belgium, Italy, France and United Kingdom). The results show that there is price convergence that tends to validate the relative—and to a lesser extent the absolute—LOOP hypothesis. As the authors point out, however, it is difficult to extend this conclusion to other goods. Lutz (2003) achieves a comparable study based on the Big Mac indicator of *The Economist*, and on the price of five varieties of cars within the Eurozone. The results are at odds with those of Goldberg and Verboven (2005), since the

introduction of the euro seems to have only little effect.[2]

The second approach consists in transforming microeconomic panels to obtain comparable individuals (see Engel and Rogers (2004), Crucini et al. (2005), Cuaresma et al. (2007) and Rogers (2007)). Using the *Economic Intelligence Unit* database, Engel and Rogers (2004), Cuaresma et al. (2007), and Rogers (2007) analyze the price of "standard" goods measured in 18 cities belonging to the Eurozone. The results between Engle and Rogers (2004) and Rogers (2007) are broadly similar in the sense that a reduction in price dispersion is found before the launch of the euro, during the implementation of the European Single Act (1986). Cuaresma et al. (2007) do not witness any reduction of price dispersion after the introduction of the euro. Crucini et al. (2005) test the existence of LOOP by relying on the Eurostat database for four different years (1975, 1980, 1985, 1990), and also provide evidence of price convergence.

The third approach uses inflation rates differentials (see Honohan and Lane (2003), Arnold and Verhoef (2004), or Égert et al. (2004) among others). Beck and Weber (2005) show that the convergence process is nonlinear: adjustment speeds seem to decrease after the introduction of the euro. Moreover, they find that the dispersion of inflation rates decreases only before the introduction of the European currency.

Finally, the last approach is based on the Consumer Price Index (CPI). Camarero et al. (2000) tackle the price convergence between peripheral countries of the EU (Spain, Italy, United Kingdom) and Germany through time series unit root tests, and find evidence of a catching-up effect. Cecchetti et al. (2002) assess the price convergence between 19 US cities using panel unit root tests. According to Faber and Stockman (2009), as well as Crucini et al. (2005), CPI may be useful only for testing the relative PPP (convergence in inflation rates) and not the absolute PPP (convergence in price levels). Recalculating CPI that take into account price differentials between countries, Faber and Stockman (2009) find that price dispersion has decreased through time for countries belonging to Eurozone. Relying on the Comparative Price Levels (CPL) supplied by Eurostat, Allington et al. (2005) and Égert (2007) evidence that price levels are heterogeneous among EU-27 countries. If Égert (2007) documents the reasons of inflation divergence and argues that despite the little impact of the Balassa-Samuleson effect, structural factors affecting the tradables

[2]These results are very questionable as there is only one observation after the introduction of the euro.

and non-tradables are the main explanations of differences in price dynamics, Allington et al. (2005) put forward that euro leads to a reduction of price dispersion in EMU.

Falling in this latter approach, our aim in this chapter is to investigate price convergence among twelve countries belonging to EMU. To this end, we consider monthly data over the January 1970 to July 2011 period. Relying on cointegration techniques, we show that the underlying linear hypothesis regarding the price convergence process may be viewed as too restrictive. To overcome this limit, we account for potential nonlinearities in the price adjustment process through the estimation of smooth transition regression models. These models allow us to put forward a different behavior of prices depending on whether price differentials are above or below a certain threshold. In other words, while price convergence may not be observed in a standard linear framework, it can be at play only when price differentials are important in terms of size. Furthermore, from the estimation of these models, it is possible to deduce mean-reversion speeds in the case of convergence.

The chapter is organized as follows. Section 2.2 presents the data and some stylized facts. Section 2.3 reports the estimation results, and Section 2.4 discusses our findings. Finally, Section 2.5 concludes the chapter.

## 2.2 Data and stylized facts

Testing price level convergence amounts to testing absolute PPP. Accordingly, we use the definition of "external" real exchange rate:

$$RER = NER.\frac{P^*}{P} \tag{2.1}$$

where $RER$ is the real exchange rate, $NER$ the nominal exchange rate (expressed as the number of domestic currency units per foreign currency unit), $P$ the domestic price level, and $P^*$ the foreign price level. Obviously, within a currency union, $NER$ is equal to one since the currency is the same for all the members.

### 2.2.1 Data

Testing price convergence requires to select price series $P$ and $P^*$. From a macroeconomic viewpoint, CPI is the key indicator. Although as an index it is useful to depict the evolution of prices (inflation), it gives no indication regarding the level of prices. CPI can thus not be used for testing the convergence of price levels. To overcome this issue, we rely on the International Comparison Program (ICP) carried by the World Bank that aims at providing comparable international prices. Based on this framework, Eurostat and OECD have computed Comparative Price Level (CPL) series for each European country. These CPLs are defined by the OECD as the ratio between purchasing power parity conversion factor for private consumption[3] and the nominal exchange rate. This ratio measures price level differences between two countries (in our case between a European country and the United States) and can be expressed as follows:

$$CPL_{i,t} = \frac{PPP_{i,t}}{NER_{i,t}} \times 100 \tag{2.2}$$

where $PPP_{i,t}$ stands for the PPP conversion factor for private final consumption of country $i$ relative to the United States at time $t$, expressed in euros per US dollar, and $NER_{i,t}$ is the euro/dollar exchange rate at time $t$. Turning to data availability, CPLs are computed by Eurostat and OECD for each European country annually only since 1995. It is however possible to recover observations previous to 1995 using the price evolution relative to the US in each European country—i.e. using the relative CPIs corrected by the exchange rate variations. More specifically, we construct the monthly domestic price level series of country $i$ on the period from January 1970 to July 2011 as follows:

$$P_{i,t} = \frac{PPP_{i,2005}}{NER_{i,2005}} \times \frac{\frac{CPI_{i,t}}{CPI_{i,2005}}}{\frac{NER_{i,t}}{NER_{i,2005}} \times \frac{CPI_{US,t}}{CPI_{US,2005}}} \times 100 \tag{2.3}$$

where $i = 1, ..., 12$ denotes the European country. $PPP_{i,2005}$ is the PPP for private consumption for country $i$ relative to the US in 2005 (euros per US dollar). $CPI_{i,t}$, $CPI_{i,2005}$, $CPI_{US,t}$ and $CPI_{US,2005}$ are respectively the country $i$'s CPI at time $t$ and at year 2005,

[3]Following the World Bank definition, the PPP conversion factor for private consumption is the number of units of a country's currency required to buy the same amount of goods and services in the domestic market as a US dollar would buy in the United States, the conversion factor being applicable to private consumption.

and the US CPI at time $t$ and at year 2005. $NER_{i,2005}$ is the euro/dollar exchange rate in year 2005. 2005 has been chosen as the basis year because it corresponds to the year of the last ICP survey realized by the World Bank.[4] From Equation (2.3), we thus obtain 12 series of price levels that can be used to test for price convergence. Given the importance of Germany in the Eurozone, we retain this country as the benchmark, and investigate convergence between each domestic price level series and the German one.

### 2.2.2 Stylized facts

Figure 2.1 depicts German and domestic price levels (in logarithms) for each country over the period from January 1970 to July 2011. Price differentials and their evolution are quite different across countries during the period under study. Three groups can be distinguished. The first group is characterized by some price differentials at the beginning of the period that tend to fill over time. Countries such as Austria, the Netherlands, Belgium, France, Luxembourg, and Italy belong to this group. Within this group, some differences across countries have however to be mentioned. Austria and the Netherlands exhibit a similar pattern in the sense that price differentials with Germany tend to disappear at the end of the period—price level series being indeed very close in the 2000s. Belgium, France and Luxembourg experience some price differentials at the beginning of the period, that tend to be highly reduced after the implementation of the Single Act before exhibiting higher domestic price levels than Germany in the 2000s. Italy can be added to this first group of countries since its price differential with Germany, while being important at the beginning of the period, is also very weak in the 2000s. In the second group, made of Finland and Ireland, domestic prices are higher than the German price level most of the time. Important gaps are at play, that are not filled but tend to stabilize at the end of the period, specially for Finland. In the last group, composed by Greece, Portugal, and Spain, important negative price differentials are at play, domestic prices being always lower than the German level. For these three countries, the price gaps tend to diminish across time, specially since the mid-1990s. Finally, all price series show a global upward trend and evidence of non-stationarity.

[4] $PPP$ series are extracted from the OECD database. NER and CPI series are from IFS, except the German and the Irish CPIs that come from Datastream.

Figure 2.1: **Price levels (in logarithms)**

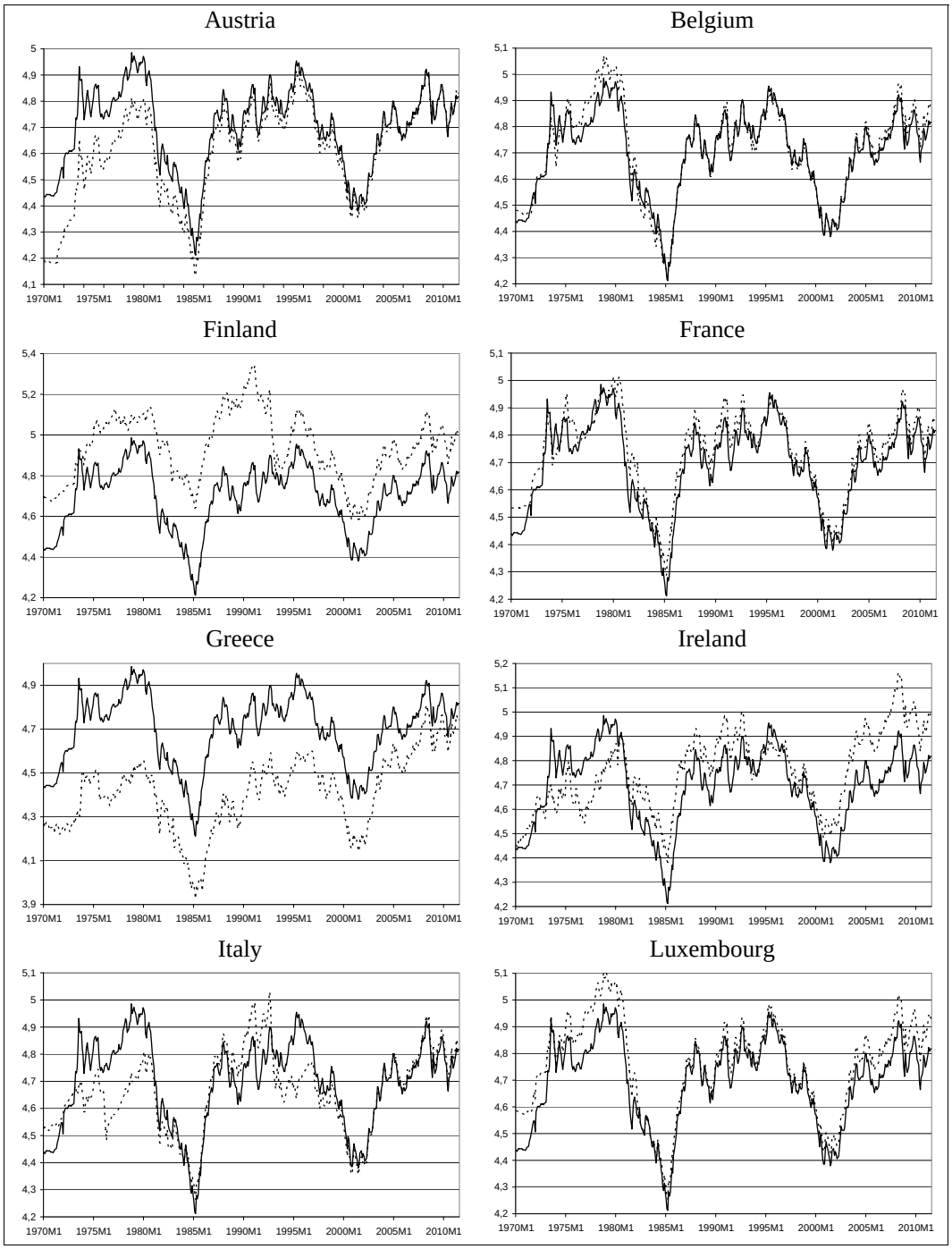
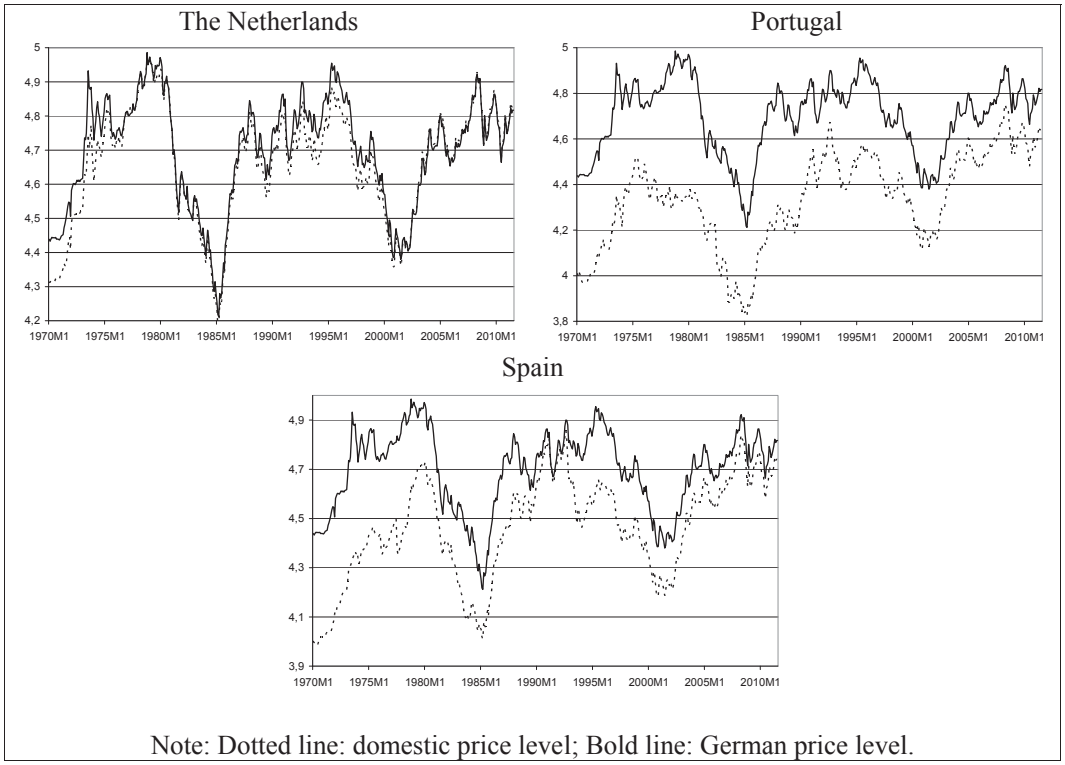


Figure 2.1: **(Continued) Price levels (in logarithms)**




Note: Dotted line: domestic price level; Bold line: German price level.

## 2.3 Testing price convergence: Empirical analysis

### 2.3.1 Cointegration analysis

To assess convergence between price series, we rely on unit root and cointegration techniques by estimating an ADF-type equation:[5]

$$\Delta x_t = k + \phi x_{t-1} + \sum_{i=1}^{p} \phi_i \Delta x_{t-i} + \epsilon_t \tag{2.4}$$

where $x_t$ denotes the differential between domestic ($P_t$) and German ($P_t^*$) prices (in logs):

$$x_t = \ln P_t - \ln P_t^* \tag{2.5}$$

If the null hypothesis $\phi = 0$ in Equation (2.4) is rejected, the price differential is non-stationary, meaning that there is no price convergence. In the case where the null is rejected, it is possible to calculate the half-life of deviations ($-\ln(2)/\ln(1+\phi)$) which provides an indication regarding the speed of price mean reversion.

We divide our whole period into three sub-samples in order to account for the different steps of the EMU construction. The first period concerns the Common Market (established by the Rome Treaty in 1953) and ends in 1987 with the implementation of the Single Act. The latter defines the second period starting on July 1987 and ending in December 1998. The last period starts with the introduction of the euro in January 1999.

Results of cointegration tests are presented in Table 2.1 which displays the $p$-values relating to the ADF-type test[6] and the half-life of deviations (in years). With the exception of some few special cases,[7] there is no convergence at all since the tests fail to reject the null

[5] Previous to the application of cointegration tests, a battery of unit root tests have been applied showing that all price series are integrated of order one. The detailed results are available upon request from the authors. Note that Equation (2.4) does not include a deterministic trend, the latter being non significant.

[6] Johansen (1988, 1991)'s tests have also been applied, leading to the same conclusions.

[7] At the 1% significance level, the null hypothesis of no cointegration is rejected for Portugal and Spain at the end of the period, and for Austria during the second sub-period. Note however that half-lives for Portugal and Spain are quite long, meaning that price convergence, when it exists, takes a long time.

Table 2.1: **Cointegration tests results**

| | 1970.01-1987.06 | | 1987.07-1998.12 | | 1999.01-2011.07 | |
|---|---|---|---|---|---|---|
| | p-value | Half-life | p-value | Half-life | p-value | Half-life |
| Austria | 0.0700* | 48 | 0.0001*** | 0.2 | 0.6677 | |
| Belgium | 0.3824 | | 0.2513 | | 0.8373 | |
| Finland | 0.7334 | | 0.7609 | | 0.1358 | |
| France | 0.0661* | 2 | 0.5410 | | 0.3531 | |
| Greece | 0.1180 | | 0.5343 | | 0.9717 | |
| Ireland | 0.6870 | | 0.5132 | | 0.1236 | |
| Italy | 0.3395 | | 0.6533 | | 0.1715 | |
| Luxembourg | 0.3450 | | 0.1222 | | 0.7061 | |
| Netherlands | 0.3198 | | 0.3442 | | 0.0969* | 1.6 |
| Portugal | 0.1846 | | 0.0402** | 9.8 | 0.0050*** | 12.5 |
| Spain | 0.3441 | | 0.6428 | | 0.0008*** | 5.5 |

*** (resp. **, *): rejection of the null hypothesis of no cointegration at the 1% (resp. 5%, 10%) significance level. Half-lives are expressed in years.

hypothesis of no cointegration between domestic and German prices. This absence of evidence of convergence may come from the assumption of linearity implicit in the ADF-type and Johansen tests, a hypothesis that may be too restrictive and strong. Even if economic integration of Eurozone members globally increased over time, some idiosyncratic characteristics remain (such as economic policy) that could prevent prices to converge at given times. However, this absence of convergence may be only temporary and dependent on the size of the price differential. Indeed, while convergence may not be observed for low price differentials, it can take place when domestic and German prices are highly different. In other words, it seems reasonable to think that convergence may occur only when the price differential exceeds a certain threshold since the loss of competitiveness, but also the regional commitments (such Maastricht treaty) exert a mean-reverting force. Domestic prices may thus depart from German prices until a given gap is overtaken, and the mean-reverting forces constrain members to adopt measures to ensure price convergence. This hypothesis will be tested in the next subsection, but the results of cointegration tests showing that convergence is observed for Portugal (for some subperiods) which is typically characterized by important price differentials are consistent with our intuition.

### 2.3.2 Nonlinear analysis

To investigate the nonlinearity of the price convergence process, we proceed to the estimation of smooth transition regression (STR) models. These models are characterized by the existence of two regimes—corresponding respectively to low and high price differentials—the transition from one regime to the other being smooth and determined endogenously depending on the value of an observed, transition variable. They are particularly suitable for our purpose since they allow us to account for the fact that correction of disequilibria may be at play when price differentials exceed a certain threshold. More specifically, the STR specification is given by:

$$\begin{aligned} \Delta x_t = & \left[\alpha_1 + \beta_1 x_{t-1} + \sum_{i=1}^{p} \phi_{1i} \Delta x_{t-i}\right] \\ + & \left[\alpha_2 + \beta_2 x_{t-1} + \sum_{i=1}^{p} \phi_{2i} \Delta x_{t-i}\right] \times F\left(\gamma, c; \Delta x_{t-d}\right) + \epsilon_t \end{aligned} \tag{2.6}$$

where $\epsilon_t$ is an i.i.d. process, $\Delta x_{t-d}$ is the transition variable ($d$ being an integer), and $F(\gamma, c; \Delta x_{t-d})$ is the transition function which is bounded between 0 and 1. $c$ denotes the threshold parameter, and $\gamma$ is the slope parameter that determines the smoothness of the transition from one regime to the other. Two transition functions are commonly considered (Teräsvirta and Anderson (1992)):

- A logistic function (LSTR model):

$$F(\gamma, c; \Delta x_{t-d}) = (1 + exp(-\gamma(\Delta x_{t-d} - c)))^{-1} \tag{2.7}$$

- An exponential function (ESTR model):

$$F(\gamma, c; \Delta x_{t-d}) = 1 - exp(-\gamma(\Delta x_{t-d} - c)^2) \tag{2.8}$$

The LSTR specification accounts for asymmetric realizations: the two regimes are characterized by different dynamics, being associated with small and large values of the transition variable relative to the threshold value. In the ESTR specification, the two regimes have similar structures, but the middle grounds are characterized by different dynamics.

Following the sequential strategy developed by Teräsvirta (1994) for the specification of STR processes, we start by applying linearity tests using the lagged price differential as the transition variable.[8] The null of linearity is rejected in favor of the nonlinear alternative for all countries, but Finland. The LSTR alternative is retained for seven countries; France, Portugal and Spain being the countries for which the null hypothesis is rejected in favor of the ESTR alternative.

Table 2.2: **Estimation results of STR models (whole sample)**

| | Model | $\beta_1$ | $\beta_2$ | $\beta_1 + \beta_2$ | linear half-life | non-linear half-life | $\hat{c}_1$ | $\hat{c}_2$ |
|---|---|---|---|---|---|---|---|---|
| Austria | LSTR | -0.0012 | -0.0130** | -0.0142 | | 4.03 | -0.0028 | |
| Belgium | LSTR | -0.0124 | -0.1527*** | -0.1651 | | 0.32 | 0.0141 | |
| Finland | | | Null hypothesis of linearity not rejected | | | | | |
| France | ESTR | -0.0344*** | -0.3061*** | -0.3405 | 1.65 | 0.14 | -0.0412 | 0.0251 |
| Greece | LSTR | 0.0818 | -1.0155* | -0.9337 | | 0.25 | 0.1567 | |
| Ireland | LSTR | 0.9063* | -0.9453* | -0.0389 | | 1.45 | -0.0762 | |
| Italy | LSTR | -0.1801*** | 0.1706*** | -0.0094 | 0.29 | 6.11 | -0.0255 | |
| Luxembourg | LSTR | -0.1094*** | 0.0953*** | -0.0140 | 0.49 | 4.08 | -0.0082 | |
| Netherlands | LSTR | 1.1419*** | -1.1653*** | -0.0233 | | 2.45 | -0.0233 | |
| Portugal | ESTR | -0.0039 | -0.3149*** | -0.3189 | | 0.15 | -0.0501 | 0.0505 |
| Spain | ESTR | -0.1380** | 0.1685 | 0.1547 | 4.16 | | -0.0575 | 0.0589 |

*** (resp. **, *): significant at the 1% (resp. 5%, 10%) level. Half-lives are expressed in years.

Results in Table 2.2 put forward the interest of our nonlinear modelling: while results from standard tests globally revealed no evidence of price convergence, the findings from STR estimations show that this phenomenon is observed for all countries of our panel. Austria, Belgium, Greece, Ireland, the Netherlands and Portugal exhibit price convergence only in the nonlinear regime, whereas France, Italy and Luxembourg experience convergence in both linear and nonlinear regimes. The fact that price convergence is obtained for most countries in the nonlinear regime validates our previous hypothesis: the correction of disequilibria only takes place when price differentials exceed a certain level. The latter is given by the estimated value of the threshold parameter.[9] The value of $\hat{c}_1$ is quite heterogeneous accross countries. It is very low for Austria, confirming the graphical analysis (see Figure

[8]The complete results are available upon request from the authors. Following Teräsvirta (1994), the number of lags for the transition variable has been selected by minimizing the $p$-values of the linearity tests.

[9]Recall that, due to the non stationarity of the price differential, the transition variable $x_{t-d}$ is expressed

2.1) showing very small price differentials between Austria and Germany. More generally, the value of $\hat{c}_1$ in the LSTR specification is lower for countries belonging to the first group of economies previously identified, varying between -2.55% for Italy to 1.41% for Belgium. Turning to Ireland, disequilibria are corrected only when price differentials are important, exceeding 7.62%, while Portuguese disequilibria are not corrected when price differentials are in the [-5%, 5%] interval. The case of Greece is particularly interesting since disequilibria are corrected only for (very) high values of the price differential, the estimated threshold value—close to 16%—being the largest of our sample of countries.

Mean-reversion speeds (or, equivalently, half-lives) are also quite heterogeneous across countries. More specifically, paying a special attention to the nonlinear regime, Belgium, France, Greece, and Portugal exhibit very fast convergence, i.e. half-lives below one year. In France, half-lives of deviations are lower in the nonlinear regime than in the linear one, indicating that corrections of disequilibria are more rapid when these deviations are high. Ireland and the Netherlands enhance a relatively fast convergence—with half-lives comprised between 1.45 and 2.45 years—while Austria, Luxembourg and Italy experience relatively low convergence (half-lives larger than 4 years) that goes against the PPP on the short run. Results concerning the mean-reversion speeds of Euroland core (Austria, Belgium, and France) are in line with the expectations. The rapid convergence speeds of peripheral countries, as Greece and Portugal, and to a lesser extent Ireland, is consistent with the current wisdom that these countries tend to converge too quickly in case of large deviations, a fact that may be linked to their fragile economic situations, specially for Greece (see below).

Finally, Finland is the only country that does not exhibit price convergence, confirming the long-lasting price differential observed in Figure 2.1. One possible explanation may come from the "Scandinavian model" involving that Finland's economic structures are quite different from those of Continental or Mediterranean countries, making this economy relatively more "independent" from the Eurozone than the other members. In other words, Finland may have experienced idiosyncratic economic fluctuations that are not correlated to the rest of the Eurozone, such as the banking crisis of the early 1990s. The entry in the European Union in 1995 and in EMU in 1999, may tend to erase this idiosyncrasy, increasing the correlation of the economy with the rest of the Eurozone. However, due to

in first difference. Consequently, the value of the threshold parameter $\hat{c}_1$ in the LSTR specification should be interpreted in absolute terms, its sign depending on the sign of the price differential.

data availability issues, this long-run phenomenon is not caught by our study.

## 2.4 Analysis of the results

To explain and assess the relevance of the obtained mean-reversion speeds, we rely on the evolution of competitiveness in EMU. To this end, we (i) first review a panel of general macroeconomic indicators that account for price-competitiveness, (ii) focus on labor market institutions since they may be the source of some rigidities that hamper price convergence, and (iii) then pay interest to the production patterns (specialization) because they partly determine non-cost competitiveness.

### 2.4.1 Price competitiveness

Price competitiveness can be simply defined as the capacity to defend or conquer market shares on domestic as well as on foreign markets by offering lower prices than competitors. One of the most important leverage of price-competitiveness is certainly productivity, as pointed out by Fleming (1971) when studying price convergence. However, several other indicators also exist, some of them being displayed in Table 2.3 together with productivity. The first four measures are real indicators and relate to the efficiency of production. The fifth indicator (current account) is a monetary indicator that allows to appraise the external competitiveness encompassing under/over-valuations of exchange rates. Finally, the last one is the productivity per hour in euros, which is a proxy of the productivity level.

Focusing on the countries that belong to the core of the Eurozone, the evolution of the macroeconomic indicators between the periods 1987-1998 and 1999-2009 is mixed. In Austria, price-competitiveness has been preserved, while it has somewhat deteriorated in France and Belgium. Indeed, although all countries have experienced a decrease in the GDP as well as in the productivity growth rates, the fall is more marked in Belgium and France. Current accounts uphold this general picture with balances improved in Austria, and degraded in Belgium and France (even if they present surpluses indicating that they still are competitive). The Netherlands, the last country belonging to the core, is atypical. Despite showing fundamentals below the average in terms of output and productivity growth, inflation and unit labor costs, the Netherlands seems to be still price-competitive

Table 2.3: **Macroeconomic indicators over 1987-1998 and 1999-2009**

| | Output growth | | Productivity growth | | Inflation | | Unit labor cost growth | | Current account | | Productivity level |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | 87-98 | 99-09 | 87-98 | 99-09 | 87-98 | 99-09 | 87-98 | 99-09 | 87-98 | 99-09 | 2009 |
| Austria | 2.54 | 1.87 | 1.50 | 1.41 | 2.45 | 1.85 | 1.18 | 1.02 | -2.75 | 1.65 | 38.1 |
| Belgium | 2.39 | 1.72 | 2.18 | 0.85 | 2.18 | 2.04 | 2.17 | 2.11 | 5.25 | 2.70 | NA |
| Finland | 2.20 | 2.26 | 3.12 | 1.59 | 3.04 | 1.61 | 2.01 | 2.16 | 4.75 | 5.90 | 39.1 |
| France | 2.21 | 1.61 | 2.30 | 1.21 | 2.31 | 1.61 | 1.19 | 1.79 | 2 | 0.49 | 45.6 |
| Germany | 2.51 | 0.95 | 2.48 | 1.09 | 2.45 | 1.46 | 1.80 | 0.61 | -0.75 | 3.15 | 40.9 |
| Greece | 1.79 | 3.32 | 1.29 | 2,37 | 12.67 | 3.24 | 12.92 | 3.43 | NA | -8.55 | 19.5 |
| Ireland | 6.30 | 4.33 | 4.53 | 2.91 | 2.57 | 2.69 | 1.47 | 2.76 | 2.25 | -1.96 | 46.8 |
| Italy | 1.97 | 0.60 | 1.73 | 0.13 | 4.66 | 2.16 | 3.74 | 2.69 | 2.5 | -1.25 | 31.4 |
| Luxembourg | 5.12 | 4.02 | 2.32 | 0.72 | 2.12 | 2.22 | 1.70 | 2.88 | 10.75 | 9.80 | NA |
| Netherlands | 3.09 | 1.86 | 1.88 | 0.98 | 1.95 | 2.06 | 1.38 | 2.42 | 5 | 5.10 | 45.2 |
| Portugal | 3.83 | 1.22 | 3.25 | 1.31 | 7.45 | 2.48 | 7.96 | 2.65 | -4.25 | -9.60 | 16 |
| Spain | 3.13 | 2.80 | 1.73 | 0.88 | 4.73 | 2.81 | 5.30 | 2.92 | -0.25 | -5.90 | 30 |
| Average of the 12 countries | 2.94 | 2.21 | 3.57 | 1.29 | 4.05 | 2.19 | 3.57 | 2.29 | 2.27 | 0.14 | 35.26 |

Source : OECD and Eurostat. This table reports the annual growth rates of GDP, productivity, unit labor cost, as well as the current account balances, the inflation rate and the productivity per hour in euros.

since it exhibits large current account surpluses that tend to increase between the two periods, and also one of the highest productivity level of the zone.

Paying now attention to the peripheral countries, the situations of Greece, Ireland, Portugal and Spain are even more heterogeneous. The high GDP and productivity growth rates during the two periods markedly above the average of the zone, the increase of the costs (with inflation rates and unit labor costs slightly above the partners average) as well as the severe degradation of the current account denote a loss of price-competitiveness and are strong evidences that Ireland has experienced a Balassa-Samuelson catching-up phenomenon. The latter is moreover confirmed by the productivity level that is the highest of the Eurozone. Thereby, the relatively fast mean-reversion speed is not surprising. The case of the remaining countries is much controversial. In Greece, GDP and productivity growth rates are low and far under the Eurozone average in the first period, even if after 1999, there is a real improvement of these two indicators. However, the inflation level, the expansion of labor costs and the massive deficit of current accounts support the view that the convergence speed is too high for Greece. The convergence of prices is not due to an economic catching-up since the productivity level is far under the average of the zone,

but rather to a tremendous loss of price-competitiveness. To a lesser extent, Portugal and Spain experience the same process. The productivity and GDP gains are not sustained enough within and between the two periods to evidence a Balassa-Samuelson effect, the productivity levels are low, especially for Portugal that enhances the lowest level of the panel. The pace of inflation and the increase in unit labor costs are much above the partners average. Moreover, current accounts exhibit deficits that boom in the second period, suggesting that the euro was probably overvalued for these two countries.

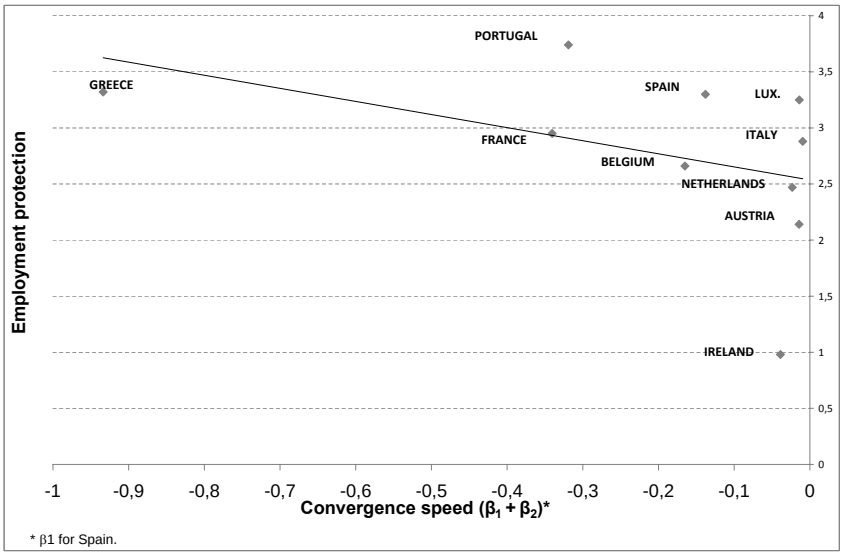
Concerning Italy, the indicators follow a downward slope. Economic performances are largely beyond that of the European average and have worsen between the two periods. Growth and productivity gains are apathetic, and even if inflation is controlled in the second period, it remains above or very close to the average, just as the unit labor cost. Moreover, the current account surplus of the first period turns to a deficit in the second period, and productivity level is below the average. In the light of these analyses, it appears that Italy has, just as Greece, Spain and Portugal, suffered from a harsh loss of price-competitiveness. The difference with the peripheral countries is that domestic price levels are higher, and the quite elevated half-lives previously found is consistent with the economic situation of the country.

### 2.4.2 Labor market

Labor market institutions may also provide useful informations regarding competitiveness and convergence inside a monetary area. Indeed, in the tradition of the creative destruction literature (Schumpeter, 1942), Bartelsman and Doms (2000) and Lentz and Mortensen (2005) find evidence of a positive relationship between factor reallocation (especially labor) and productivity growth. Hence, labor market institutions that experience some rigidities as high levels of employment protection or high shares of long-term unemployment, may fail to fairly reallocate resources when innovations appear and technical progress is diffused within the economy, which in turn hampers productivity growth. Moreover, these kinds of rigidities are taken into account by companies when they decide to invest, and, other things being equal, high rigidities may disincentive investments which restraints again innovation and technical progress diffusion. The case is particularly crucial for countries that have a low level of productivity and need technological transfers (through FDIs) to improve it, such as Greece or Portugal.

To investigate the relationship between labor market rigidities and convergence speed, we rely on the following indicators retrieved from the OECD database:[10] the level of employment protection (the higher the value, the higher the protection) displayed in Figure 2.2, the share of long-term unemployment in total unemployment, and the percentage of GDP devoted to programs of "active" unemployment policies (such as training, employment incentives, or supported employment) reported in Table 2.4.

Figure 2.2: **Employment protection (1985-2009 average) and convergence speed**




The employment protection indicator[11] is a synthetic index that *"measures the procedures and costs involved in dismissing individuals groups of workers and the procedures involved in hiring workers on fixed-term or temporary work agency contracts"* (OECD). According to Figure 2.2, three groups of countries can be distinguished. The first group includes countries that are characterized by high employment protection levels: Portugal, Greece, Luxembourg, and Spain. On the sole basis of this indicator, price convergence appears too fast in Portugal and, to a lesser extent, Spain and Luxembourg: the labor market

[10] Except for Belgium for which data on employment protection were unavailable.

[11] The values for employment protection are the average on the 1985-2009 period, except for Luxembourg for which the 2009 value is considered.

fails to provide enough labor mobility to allow for price convergence without prejudicing productivity (and hence price-competitiveness). Greece is characterized by both a very high convergence speed and low labor mobility, appearing as isolated from the rest of the countries regarding these statistics. In the second group, composed by Belgium, France, Italy, and the Netherlands, price convergence speeds seem to be consistent with the degree of employment protection: labor is mobile enough to maintain productivity growth, confirming the results found in Subsection 2.4.1. Finally, Austria and Ireland should have experienced a faster convergence speed given the labor rigidities.

Rigidities are a multidimensional phenomenon that cannot be approached only by a sole proxy. Variables listed in Table 2.4 aim at controlling the degree of reallocation from (i) the long-term unemployment share in the total unemployment, and (ii) policies favoring labor mobility. The interesting cases are those of Greece, Italy, Portugal and Spain. These countries are characterized by high long-term unemployment shares in the total unemployment (long-term unemployment is around or above 50% of total unemployment) combined with poor active programs destinated to improve mobility. With regard to employment protection, these countries suffer from a lack of labor mobility that harms their productivity.

Table 2.4: **Long-term unemployment and active programs**

| | Share of long-term unemployment | Share of GDP dedicated to active programs |
|---|---|---|
| Austria | 25.29% | 0.48% |
| Belgium | 53.50% | 1.15% |
| France | 38.87% | 0.97% |
| Greece | 51.92% | 0.23% |
| Ireland | 41.88% | 0.97% |
| Italy | 56.17% | 0.51% |
| Luxembourg | 27.76% | 0.43% |
| Netherlands | 38.96% | 1.32% |
| Portugal | 45.47% | 0.51% |
| Spain | 42.84% | 0.66% |

Source: OECD. The values are the averages of the period 1985-2009 except for active programs in the case of: Greece (1985-1997), Italy (2004-2009), and Luxembourg (2002-2009).

### 2.4.3 Specialization

Until now, we have only paid attention to price-competitiveness. There is however a second side in competitiveness that is likely to influence price levels: non-cost competitiveness. This kind of competitiveness consists for a producer in differentiating its products in order to evade market laws, and carry out a higher price than in perfect competition. At a country level, the main strategy is to specialize in high technological industries. The issue comes from heterogeneity in specialization among members of a single currency area, because there are two opposite price dynamics at play. On the one hand, countries specialized in low technology are rather the less advanced of the zone, and exhibit low price levels. They compete thanks to low prices and are very sensitive to costs increase and nominal exchange rate appreciation. On the other hand, countries specialized in high technological industries are the leaders of the zone and exhibit high price levels. Other things equal, they are less sensitive to costs increase and exchange rate appreciation. Since price convergence operates toward leaders' price levels, countries specialized in low technological industries have to "go upmarket" (i.e. specialize in high tech industries), otherwise it entails a dramatic loss of price-competitiveness. This might be one of the explanation to the problems of EMU, in particular for Greece and Portugal.

Here, we aim at testing this hypothesis. It is however difficult to find measures of specialization. To overcome this issue, we construct a simple index of technological specialization on the basis of the revealed comparative advantages for the manufacturing CITI indicator (see Appendix 1 for the construction of the index). The underlying idea is that the technological content illustrates a non-cost competitiveness tendency.

Table 2.5 reports the technological specialization as well as the openness rate for each country during the periods 1987-1998 and 1999-2009. Again, we can classify the countries in different categories:

- Our benchmark country, Germany is specialized in industries with high technological contents: its products are innovative, or positioned on the high quality segment, which allows it to discriminate its prices.

- Austria, Finland, France, and the Netherlands own at equal shares high and medium technology industries. They have a lower market power than Germany, even if it remains substantial.

Table 2.5: **Technological specialization in 1987-1998 and 1999-2009**

| | Specialization | |
|---|---|---|
| Period | 87-98 | 99-09 |
| Austria | high technology | high technology |
| Belgium | medium technology | medium technology |
| Finland | high technology | high technology |
| France | high technology | high technology |
| Germany | superior technology | superior technology |
| Greece | low technology | low technology |
| Ireland | medium technology | medium technology |
| Italy | medium technology | medium technology |
| Luxembourg | NA | NA |
| Netherlands | high technology | high technology |
| Portugal | low technology | low technology |
| Spain | medium technology | medium technology |

Source : OCDE. NA : non available.

- Belgium, Ireland, Italy and Spain are mainly specialized in medium-technology sectors, and have very few high-tech industries. Moreover, low-technology sectors represent an important part of specialization in Spain and Italy.

- Greece and Portugal are mostly specialized in low-technology industries, facing a strong competition in prices.

The core of Eurozone (Austria, Belgium, France, the Netherlands, and Germany) is constituted by countries that are specialized in high-technology industries (except Belgium). It is interesting to notice that it surely might be thanks to its specialization that the Netherlands do not have experienced a greater loss of competitiveness. In contrast, Belgium succeeds to maintain its competitiveness despite the lower technological content of its industries relative to the other core countries. Coming after these leaders, Ireland, Italy and Spain present medium technology industries. If Ireland is a special case due to strong evidence of a Balassa-Samuelson catching-up effect, Italy and Spain failed to evolve their industries to more technological contents, which has been detrimental to their competitiveness: the low mean-reversion speeds we found are then consistent. The case of Greece and Portugal is even more evocative: just as Italy and Spain, they failed to climb the technological ladder, but since they were below these latter, the loss of competitiveness is even greater, which supports the view that they are experiencing a too fast price convergence speed.

## 2.5 Conclusion

Very few studies analyze price convergence in the Eurozone despite the fact that this criterion conditions the optimality of any monetary union. To compensate for that lack, this chapter investigates the convergence between price levels of twelve Eurozone members on the January 1970-July 2011 period. Relying on smooth transition regression (STR) models, we show that the price adjustment process is nonlinear, depending on the size of the price differential: for most countries, price convergence occurs only when price differentials across members exceed a certain threshold. Moreover, our findings put forward some heterogeneity across the Eurozone members in terms of price convergence speed, that we explain by relying on competitiveness indicators and countries' technological specialization patterns. The core group of countries composed by Austria, Belgium, France and the Netherlands is characterized by relatively high price convergence speeds relative to Germany, in line with their price-competitiveness indicators, their market labor structures, and their specializations in high-technology products. The high convergence speeds observed in peripheral countries, such as Greece and Portugal which are specialized in low-technology products, mainly come from their loss in price-competitiveness. Finally, our findings obtained for Ireland reflect that this country has experienced a Balassa-Samuelson catching-up phenomenon.

Despite their interest, our results provide evidences only on a large period (1970-2011). If this latter is necessary to handle a time-series analysis with the desired properties (mainly robustness), it presents a major shortcoming: it is not possible to take into account the effects of the successive market and monetary integration steps that took place during the period. Nonetheless, they may not be neutral on the price dynamics of the European countries. For example, the Single Act was implemented in 1987 in order to create a Single market supposed to foster price convergence. Regarding the monetary systems, they have also evolved since 1970: if it was possible to adjust parities (under specific conditions) during the European Monetary Snake (1972), and further with the European Monetary System (1979), these adjustments are impossible inside the Euro, which may impact price dynamics.

To overcome this shortcoming, we propose to adopt a panel data analysis that allows to split the time period taking advantage from increased dimension provided by the individuals.

## 2.6 Appendix

The definition of the technological specialization is based on the revealed comparative advantages for trade micro-indicators in the manufacturing category (CITI database, available on OECD). Table 2.6 reports the sector associated to each number.

Table 2.6: **Definition of CITI indexes**

| Index | Definition |
|---|---|
| 15 | food products and beverages |
| 16 | tobacco products |
| 17 | textiles |
| 18 | wearing apparel ; dressing and dyeing of fur |
| 19 | dressing of leather ; luggage |
| 20 | woods and products of wood and cork (except furnitures) |
| 21 | paper and paper products |
| 22 | publishing, printing and reproduction of recorded media |
| 23 | coke, refined petroleum products and nuclear fuel |
| 24 | chemical products |
| 25 | rubber and plastic products |
| 26 | non metallic mineral products |
| 27 | basic metals |
| 28 | fabricated metal products (except machinery and equipments) |
| 29 | machinery and equipment n.e.c. |
| 30 | office, accounting and computing machinery |
| 31 | electrical machinery and apparatus n.e.c. |
| 32 | radio and television communication equipment |
| 33 | medical, precision and optical instruments |
| 34 | motor vehicles, trailers and semi-trailers |
| 35 | other transport equipment |
| 36 | furniture, manufacturing n.e.c. |

Source : CITI, OECD.

On the basis of the analysis of these indexes at a disaggregated level, we consider the following typology:

- Specialization in low technology sectors: indexes 15 to 21.
- Specialization in medium technology sectors: indexes 22 to 28 and 36.
- Specialization in high technology sectors: indexes 29 to 35.

Note that index 23 has a high technology industry, that of nuclear, in which only France is specialized. Accordingly, we consider that for France index 23 testifies a high technology specialization. In Table 2.7, we report for the two sub-periods the sectors in which countries are specialized.

Table 2.7: **Specialization of Eurozone members based on comparative revealed advantages**

| | Specialization | |
|---|---|---|
| Period | 1987-1998 | 1999-2009 |
| Austria | 17, 19, 20, 21, 22, 25, 27, 28, 29, 31, 34, 36 | 15, 16, 19, 20, 21, 22, 25, 26, 27, 28, 29, 31, 34, 36 |
| Belgium | 15, 17, 23, 24, 25, 26, 27, 34 | 15, 17, 21, 23, 24, 25, 26, 27, 34 |
| Finland | 20, 21, 22, 27, 28, 29, 31, 32, 35, 36 | 20, 21, 22, 27, 28, 29, 31, 32, 35, 36 |
| France | 15, 22, 23, 24, 25, 26, 28, 31, 34, 35 | 15, 21, 22, 23, 24, 25, 26, 28, 29, 31, 33, 34, 35 |
| Germany | 21, 24, 25, 26, 29, 31, 33, 34, 35 | 16, 21, 24, 25, 29, 31, 33, 34, 35 |
| Greece | 15, 16, 17, 18, 26, 27 | 15, 16, 17, 18, 22, 25, 26, 27, 28 |
| Ireland | 15, 22, 24, 30 | 15, 22, 24, 30 |
| Italy | 17, 18, 19, 26, 28, 29 | 15, 17, 18, 19, 21, 26, 28, 29 |
| Netherlands | 16, 22, 23, 24, 25, 30, 33 | 16, 22, 23, 24, 30, 33 |
| Portugal | 15, 17, 18, 19, 20, 21, 26, 28, 31, 34, 36 | 15, 16, 17, 18, 19, 20, 21, 23, 26, 28, 31, 34, 36 |
| Spain | 15, 19, 23, 25, 26, 27, 28, 34 | 15, 19, 21, 23, 24, 25, 26, 27, 28, 34 |

Source: classification established by the authors on the basis of CITI and OECD data.

# Chapter 3

# Is price dynamics homogeneous across Eurozone?[1]

[1] Note: A first version of this chapter has been published as Guerreiro, D., Joets, M., and V. Mignon (2012), "Is price dynamics homogeneous across Eurozone?", *Journal of Economic Integration*, *forthcoming*.

## 3.1 Introduction

Since 2009, EMU is experiencing serious economic troubles that now challenge its stability, and, to a certain extent, even its existence. Triggered by high debt ratios relative to GDP, high deficits, and low growth expectations, a sovereign debt crisis has arisen in peripheral countries. Greece, Ireland and Portugal have been forced to ask the Troïka[2] for financial assistance, while Spain, even if it has succeeded to avoid such assistance, has experienced a large increase in its debt financing costs. The crisis has also reached the core of EMU, as evidenced by the large increase of spreads between Italian and German bonds, and, to a lesser extent, between French and German bonds.

If the roots of such a crisis are obviously multiple, one of the main reason would be the possible heterogeneity of price dynamics among members. In order to constitute a viable currency area, the founding members of Eurozone have developed, since the beginning of the EMU, a number of rules to ensure economic convergence, as stated in the Maastricht Treaty (1992) completed by the Pact of Stability and Growth (1997). One of the crucial rules is surely price stability: members' inflation rates should not exceed by at most 1.5 points the mean of the three lowest inflation rates. Although this is intended to render the *"one-size-fits-all"* monetary policy efficient, it also has consequences on the price dynamics that may differ with the reality of the EMU.

Inside a monetary union, implementing the convergence of inflation rates is intended to avoid asymmetric disequilibria coming from a loss of price competitiveness. However, it also supposes strong economic homogeneity regarding per capita income and productivity levels. More importantly, inflation rates convergence in a monetary union also implies price levels to be close to those determined by the absolute purchasing power parity (PPP) hypothesis.

Such a constraint may be viewed as very strong given the economic differences between the core of EMU and the periphery. Balassa-Samuelson phenomena inducing price catching-up are expected in peripheral countries, leading to heterogeneous convergence speeds depending on the group of countries—the extreme case being non convergence of price levels—and challenging absolute (and hence relative) PPP. In that case, common monetary policy may be inadequate because of its pro-cyclicality. On one hand, it could be too restrictive for

[2]Namely, EU, ECB, and IMF.

advanced economies, and lead to deflationary pressures. On the other hand, it could be too incentive for countries experiencing a catching-up: because of negative or low real interest rates, debt bubbles may appear, conducting to worsen internal imbalances (excess leverage, asset price bubbles), and external deficits. Testing for absolute price convergence would allow us to investigate whether these processes may have materialized after the launch of the euro, partly conducting to the sovereign debt crisis.

Only a few papers deal with price convergence inside the EMU. Articles generally focus on the reasons explaining heterogeneity in inflation rates (see for example Engel and Rogers (2001), Honohan and Lane (2003), Arnold and Verhoef (2004), or Égert et al. (2004)), but very few investigate price dynamics empirically (i.e. validation of absolute PPP), mainly because of the lack of available data. The differences between the existing studies come from the datasets used. Some rely on microdata—Engel and Rogers (2004), Crucini et al. (2005), Cuaresma et al. (2007) and Rogers (2007)—while others use aggregate data—Camarero et al. (2000), Allington et al. (2005), Égert et al. (2007), or Faber and Stockman (2009).

Among the studies using microdata panels, Engel and Rogers (2004), Cuaresma et al. (2007) and Rogers (2007) consider data from the *Economic Intelligence Unit* and pay attention to the price of "standard" goods measured in 18 cities belonging to the Eurozone. Engel and Rogers (2004) and Rogers (2007) find a reduction of price dispersion during the implementation of the Single Act (1986), but the introduction of the euro seems to have had little effect, which is supported by the results of Cuaresma et al. (2007). Crucini et al. (2005) test the validity of LOOP (Law Of One Price) using Eurostat data for four different years (1975, 1980, 1985 and 1990). They show that LOOP is violated only for a little numbers of products, tending to validate absolute PPP.

Studies using aggregate data provide results that go in the same direction. Camarero et al. (2000) evidence a catching-up effect for peripheral countries (Spain, Italy, and UK) relative to Germany, by implementing time series unit root tests with structural breaks on CPI differentials.[3] Employing Comparative Price Levels (CPLs) provided by Eurostat, Allington et al. (2005), on the one hand, put forward a significant effect of the euro on price dispersion, while Égert (2007), on the other hand, argues that the divergence in

[3]We will evidence in Section 3.2 that this methodology is somewhat questionable since CPI do not account for differences in price levels.

price dynamics is caused by structural factors affecting tradables and non-tradables other than the Balassa-Samuelson effect. By recalculating CPIs that account for price level differentials between countries, Faber and Stockman (2009) uphold the diminution in price dispersion across Eurozone countries. Finally, Guerreiro and Mignon (2011) highlight some heterogeneity across the Eurozone members in terms of price convergence speed, that can be explained by the evolution of price competitiveness, rigidities on the labor market and technological specialization patterns.

Our aim in this chapter is to contribute to this literature that is still in its infancy by investigating the homogeneity of price dynamics inside EMU over the January 1970 to July 2011 period. We show that to respect price stability—and hence keep the monetary union viable—one of the conditions lies in the achievement of absolute PPP. Therefore, to investigate price convergence we rely on unit root and cointegration tests. We go further than the usual time series and panel tests by accounting for both heterogeneity and cross-section dependence through the implementation of second-generation panel unit root tests, as well as structural breaks using third-generation panel tests. We also assess speeds of price convergence using the Pooled Mean Group estimator (PMG) of Pesaran, Smith and Shin (1999).

The rest of the chapter is organized as follows. Section 3.2 presents the theoretical framework and the data. Section 3.3 displays the results of unit root tests and PMG estimates, while Section 3.4 discusses our findings. Section 3.5 concludes the chapter.

## 3.2 Theoretical backgrounds and data

### 3.2.1 Theoretical backgrounds

In a two-countries model, absolute PPP is defined by:

$$e_t = p_t - p_t^* \tag{3.1}$$

where $e_t$ is the log of the spot exchange rate, and $p_t$ and $p_t^*$ respectively denote the log of the domestic and foreign price levels. Relative PPP holds when:

$$\Delta e_t = \Delta p_t - \Delta p_t^* \tag{3.2}$$

with $\Delta e_t$ denoting the variation of the log of the exchange rate, $\Delta p_t$ and $\Delta p_t^*$ the inflation rates of domestic and foreign country. If we assume now that these countries form a monetary union with a single currency, $e_t = 0$, and it comes for absolute PPP:

$$p_t - p_t^* = 0 \tag{3.3}$$

while relative PPP becomes:

$$\Delta p_t - \Delta p_t^* = 0 \tag{3.4}$$

Plugging (3.3) and (3.4), we get :

$$p_t - p_t^* = \Delta p_t - \Delta p_t^* \tag{3.5}$$

Consequently, in a monetary union, absolute and relative PPP are equivalent. In other words, convergence in inflation rates is conditioned by the fact that price levels are the same between countries. If price levels differ, the viability of the monetary area is challenged on the long run. Countries that have lower price levels are expected to catch-up their delay (Balassa-Samuelson effect), leading to higher inflation rates which goes against relative PPP inside a currency union. In a highly integrated currency union where trade barriers have disappeared, and assuming that the adjustment towards absolute PPP is made only through the goods market, a violation of absolute PPP *"signals an imbalance in the goods markets which [...] is likely to result in trade deficits"* (Juselius (2003)). Capital inflows (thanks to borrowing) are necessary to recover the equilibrium of the balance of payments. However, these massive inflows pressure upward nominal interest rates of low price countries leading to an increase of the spreads relative to high price level countries. Accumulation of deficits also leads to an increase of the debt level which in turns raises the risk premium that traduces the default risk. The combined effect of these two mechanisms—that reveals the mistrust to currency union viability—entails prohibitive financing rates, conducting to a sovereign debt crisis that spills over the union. This can be seen as a pure asymmetric shock as that presented by Mundell (1961) in the seminal paper on Optimum Currency Areas (OCA), that challenges the existence of the currency union.

### 3.2.2 Data

To test for absolute PPP, price levels of Eurozone countries are needed. CPIs are unusable since they do not account for price level differentials between countries: they only depict the evolution of prices. To overcome this issue, we rely on the International Comparison Program (ICP) carried by the World Bank that aims at providing comparable international prices. Based on this framework, Eurostat and OECD have computed Comparative Price Level (CPL) series for each European country. These CPLs are defined by the OECD as the ratio between purchasing power parity conversion factor for private consumption[4] and the nominal exchange rate. This ratio measures price level differences between two countries (in our case between a European country and the United States) and can be expressed as follows:

$$CPL_{i,t} = \frac{PPP_{i,t}}{NER_{i,t}} \times 100 \tag{3.6}$$

where $PPP_{i,t}$ stands for the PPP conversion factor for private final consumption of country $i$ relative to the United States at time $t$, expressed in euros per US dollar, and $NER_{i,t}$ is the euro/dollar exchange rate at time $t$. Turning to data availability, CPLs are computed by Eurostat and OECD for each European country annually only since 1995. It is however possible to recover observations previous to 1995 using the price evolution relative to the US in each European country—i.e. using the relative CPIs corrected by the exchange rate variations. More specifically, we construct the monthly domestic price level series of country $i$ on the period from January 1970 to July 2011 as follows:[5]

$$P_{i,t} = \frac{PPP_{i,2005}}{NER_{i,2005}} \times \frac{\frac{CPI_{i,t}}{CPI_{i,2005}}}{\frac{NER_{i,t}}{NER_{i,2005}} \times \frac{CPI_{US,t}}{CPI_{US,2005}}} \times 100 \tag{3.7}$$

where $i = 1, ..., 12$ denotes the European country. $PPP_{i,2005}$ is the PPP for private consumption for country $i$ relative to the US in 2005 (euros per US dollar). $CPI_{i,t}$, $CPI_{i,2005}$,

[4]Following the World Bank definition, the PPP conversion factor for private consumption is the number of units of a country's currency required to buy the same amount of goods and services in the domestic market as a US dollar would buy in the United States, the conversion factor being applicable to private consumption.

[5]See Guerreiro and Mignon (2011). Note that to construct the price level series, it is assumed that the reference goods basket has remained the same over the 1970-1995 period.

$CPI_{US,t}$ and $CPI_{US,2005}$ are respectively the country $i$'s CPI at time $t$ and at year 2005, and the US CPI at time $t$ and at year 2005. $NER_{i,2005}$ is the euro/dollar exchange rate in year 2005. 2005 has been chosen as the basis year because it corresponds to the year of the last ICP survey realized by the World Bank.[6] From Equation (3.7), we thus obtain 12 series of price levels [7] that can be used to test for price convergence (see Figure 3.1 in Appendix). Given the importance of Germany in the Eurozone, we retain this country as the benchmark, and investigate PPP between each domestic price level series and the German one.[8]

## 3.3 Tests and estimation results

### 3.3.1 Time series analysis

To assess PPP between each Eurozone member and Germany, we rely on unit root and cointegration techniques by estimating an ADF-type equation:[9]

$$\Delta x_t = k + \phi x_{t-1} + \sum_{i=1}^{p} \phi_i \Delta x_{t-i} + \epsilon_t \tag{3.8}$$

where $x_t$ denotes the differential between domestic ($P_t$) and German ($P_t^*$) prices (in logs):

$$x_t = \ln P_t - \ln P_t^* \tag{3.9}$$

When the null hypothesis $\phi = 0$ in Equation (3.8) is rejected, the price differential is non-stationary, meaning that PPP does not hold. In the case where the null is rejected, it is possible to calculate the half-life of deviations ($-\ln(2)/\ln(1+\phi)$) which provides an

[6] $PPP$ series are extracted from the OECD database. NER and CPI series are from IFS, except the German and the Irish CPIs that come from Datastream.

[7] Note that since our price levels have a common benchmark, the US, our series already account for nominal exchange-rate variations.

[8] In a previous version of the chapter, a Eurozone price series was constructed, and PPP was investigated between each domestic price level series and the aggregate price level series of the 11 respective partners. The results were similar to those reported here, illustrating the robustness of our results to the choice of the benchmark price level series.

[9] Previous to the application of cointegration tests, a battery of unit root tests have been applied showing that all price series are integrated of order one. The detailed results are available upon request from the authors. Note that Equation (3.8) does not include a deterministic trend, the latter being non significant.

indication regarding the speed of price mean reversion.

As evidenced by the typology of Balassa (1961), monetary union is supposed to be the final stage of an economic integration process. Integration tends to make disappear the "boarder effects", that are the measures intended to discriminate foreign goods and services relative to domestic ones. There are several kinds of discriminations: tariff barriers (as custom duties), non-tariff (quotas), or institutional (money). All these obstacles are found to hamper PPP. Consequently, we consider three sub-periods that are in line with the different steps of EMU construction. The first period, starting in January 1970, sticks with the Common Market (established by the Rome Treaty in 1953) and ends in June 1987 with the implementation of the Single Act. The latter defines the beginning of the second period, spanning from July 1987 to December 1998. The last period starts with the introduction of the euro in January 1999 and ends in July 2011. Those periods, which are distinguished here according to the integration process, are also characterized by different exchange rate regimes: a "smooth" European Monetary System (EMS) allowing some parity adjusments for the first period; strengthening of fixed exchange rates within the EMS, with decreasing possibilities of parity adjustments and the start of a nominal convergence process to meet Maastricht criteria and to enter in the monetary union for the second period; introduction of the monetary union in the third period.

Results of cointegration tests are presented in Table 3.1 which displays the $p$-values relating to the ADF-type test and the half-life of deviations (in years). With the exception of some few special cases,[10] PPP does not hold since the tests fail to reject the null hypothesis of no cointegration between domestic and German prices. These poor results and the absence of obvious convergence may come from the well-known low power of time series unit root tests against the stationary alternative in small samples. Indeed, it is a well established fact that problems of size and power are frequently associated with traditional unit root tests: in particular, they have low power (i) against I(0) alternatives that are close to being I(1), and (ii) when deterministic terms are added in the test regression.

To overcome these limitations, we implement the four efficient tests proposed by Ng and Perron (2001) which have three main advantages over the usual unit root tests: (i) no

[10] At the 1% significance level, the null hypothesis of no cointegration is rejected for Portugal and Spain at the end of the period, and for Austria during the second sub-period. Note however that half-lives for Portugal and Spain are quite long, meaning that reversion to PPP, when it exists, takes a long time.

Table 3.1: **Cointegration tests results (ADF-type tests)**

| | 1970.01-1987.06 | | 1987.07-1998.12 | | 1999.01-2011.07 | |
|---|---|---|---|---|---|---|
| | p-value | Half-life | p-value | Half-life | p-value | Half-life |
| Austria | 0.0700* | 48 | 0.0001*** | 0.2 | 0.6677 | |
| Belgium | 0.3824 | | 0.2513 | | 0.8373 | |
| Finland | 0.7334 | | 0.7609 | | 0.1358 | |
| France | 0.0661* | 2 | 0.5410 | | 0.3531 | |
| Greece | 0.1180 | | 0.5343 | | 0.9717 | |
| Ireland | 0.6870 | | 0.5132 | | 0.1236 | |
| Italy | 0.3395 | | 0.6533 | | 0.1715 | |
| Luxembourg | 0.3450 | | 0.1222 | | 0.7061 | |
| Netherlands | 0.3198 | | 0.3442 | | 0.0969* | 1.6 |
| Portugal | 0.1846 | | 0.0402** | 9.8 | 0.0050*** | 12.5 |
| Spain | 0.3441 | | 0.6428 | | 0.0008*** | 5.5 |

*** (resp. **, *): rejection of the null hypothesis of no cointegration at the 1% (resp. 5%, 10%) significance level. Half-lives are expressed in years. Source: Guerreiro and Mignon (2011).

severe size distortion in the presence of large negative moving average or autoregressive roots in the error process, (ii) power gain due to the use of a GLS detrending procedure of the data, and (iii) size and power gains resulting in the use of the modified AIC criterion (MAIC) to select the lag order $p$ in the test regression (3.8).[11] Table 3.2 reports the results of the Ng and Perron (2001) efficient modified Phillips-Perron tests, as well as the efficient modified Sargan and Bhargava (1983) and Elliott et al. (1996) tests. The results globally confirm those obtained in Table 3.1 regarding all sub-periods, failing to support the PPP hypothesis and putting forward the absence of strong convergence process between price series.

Given that we have divided our sample in three sub-periods by imposing the break locations, it would be interesting to complement our analysis using unit root and cointegration tests that endogenously detect those structural breaks. For the sake of completeness, we consequently apply two tests that account for discontinuities in the series: the Lee and

[11] As noticed by Ng and Perron (2001), the proper choice of the lag length is crucial to obtain good size and power properties. To this end, they suggest the use of MAIC instead of the usual AIC which is not well suited for integrated data. The code for implementing the Ng and Perron (2001) test is available on Pierre Perron's homepage: http://people.bu.edu/perron/code.html.

Table 3.2: **Ng and Perron (2001) tests results**

| | | | 1970.01-1987.06 | | |
|---|---|---|---|---|---|
| | Lag | $MZ_\alpha$ | $MZ_\tau$ | MSB | MERS |
| Austria | 9 | -10.89 | -2.30 | 0.21 | 8.52 |
| Belgium | 1 | -5.55 | -1.64 | 0.30 | 4.49 |
| Finland | 1 | -5.40 | -1.64 | 0.30 | 16.87 |
| France | 1 | -8.25** | -2.01** | 0.22 | 3.02** |
| Greece | 4 | -1.70 | -0.74 | 0.44 | 11.79 |
| Ireland | 12 | -7.26 | -1.90 | 0.26 | 12.56 |
| Italy | 2 | -1.86 | -0.96 | 0.52 | 13.10 |
| Luxembourg | 2 | -7.10 | -1.88 | 0.27 | 12.84 |
| Netherlands | 3 | -4.19 | -1.32 | 0.32 | 20.54 |
| Portugal | 1 | -8.55** | -1.99** | 0.23 | 3.14 |
| Spain | 1 | -12.44 | -2.46 | 0.20 | 7.50 |
| | | | 1987.07-1998.12 | | |
| | Lag | $MZ_\alpha$ | $MZ_\tau$ | MSB | MERS |
| Austria | 11 | -4.54 | -1.50 | 0.33 | 5.40 |
| Belgium | 0 | -5.96 | -1.64 | 0.28 | 4.37 |
| Finland | 1 | -4.23 | -1.44 | 0.34 | 21.43 |
| France | 0 | -7.19 | -1.88 | 0.26 | 12.70 |
| Greece | 6 | -10.49 | -2.29 | 0.22 | 8.70 |
| Ireland | 2 | -3.60 | -1.31 | 0.36 | 24.76 |
| Italy | 4 | -4.74 | -1.52 | 0.32 | 19.11 |
| Luxembourg | 5 | -5.89 | -1.71 | 0.29 | 4.17 |
| Netherlands | 6 | -3.77 | -1.16 | 0.31 | 21.31 |
| Portugal | 1 | -2.76 | -1.14 | 0.41 | 31.86 |
| Spain | 4 | -1.73 | -0.93 | 0.54 | 14.09 |
| | | | 1999.01-2011.07 | | |
| | Lag | $MZ_\alpha$ | $MZ_\tau$ | MSB | MERS |
| Austria | 10 | -5.73 | -1.65 | 0.29 | 15.82 |
| Belgium | 0 | -16.29 | -2.76 | 0.17 | 6.15 |
| Finland | 12 | -6.39 | -1.65 | 0.26 | 4.28 |
| France | 12 | -2.21 | -0.99 | 0.45 | 10.65 |
| Greece | 12 | -17.25 | -2.93 | 0.17 | 5.88 |
| Ireland | 12 | -2.05 | -0.91 | 0.44 | 10.97 |
| Italy | 3 | -3.07 | -1.14 | 0.37 | 27.35 |
| Luxembourg | 12 | -1.15 | -0.54 | 0.49 | 49.76 |
| Netherlands | 12 | -8.45 | -2.00 | 0.24 | 10.97 |
| Portugal | 12 | -10.18 | -2.17 | 0.21 | 9.34 |
| Spain | 12 | -6.46 | -1.60 | 0.25 | 14.17 |

**: rejection of the null hypothesis of no cointegration at the 5% significance level. $MZ_\alpha$: modified version of the $Z_\alpha$ Phillips-Perron test; $MZ_\tau$: modified version of the $Z_\tau$ Phillips-Perron test; MSB: modified Sargan-Bhargava (1983) test; MERS: modified Elliott et al. (1996) test. The number of lags has been selected using the modified AIC criterion.

Table 3.3: **Results of unit root and cointegration tests with structural breaks**

| | Lee-Strazicich | | | Gregory-Hansen | |
|---|---|---|---|---|---|
| | Lags | Breaks | Statistic | C | C/T |
| Austria | 7 | 2 | -5.28 | -3.27 | -3.13 |
| Belgium | 5 | 2 | -4.99 | -3.36 | -3.95 |
| Finland | 8 | 2 | -4.46 | -3.50 | -4.16 |
| France | 8 | 2 | -6.26** | -4.12 | -4.64 |
| Greece | 6 | 1 | -3.86 | -4.27 | -4.31 |
| Ireland | 6 | 2 | -3.89 | -4.21 | -4.21 |
| Italy | 1 | 2 | -4.71 | -3.61 | -3.72 |
| Luxembourg | 8 | 2 | -4.50 | -3.78 | -3.52 |
| Netherlands | 1 | 2 | -4.22 | -3.53 | -3.53 |
| Portugal | 8 | 2 | -4.42 | -3.53 | -3.58 |
| Spain | 8 | 1 | -3.11 | -3.54 | -4.62 |

**: rejection of the null hypothesis at the 5% significance level. C: model including level shift; C/T: model including level shift with trend.

Strazicich (2003) unit root test,[12] and the Gregory and Hansen (1996) cointegration test. Recall that the Lee and Strazicich (2003) test allows for a break under both the null and the alternative hypotheses, and that the Gregory and Hansen (1996) test considers the null of non-cointegration against the alternative of cointegration, with a structural break endogenously detected in the long-term relationship. With the exception of France for the Lee and Strazicich (2003) test, results given in Table 3.3 show that the null hypothesis is never rejected, going against PPP and underlining the absence of obvious convergence.

Given the absence of clear-cut results regarding the existence of a convergence process and due to the limitations of time series unit root and cointegration tests, we rely on a panel framework. Adding the individual dimension to the analysis, the use of panel data increases the power of unit root tests by raising the number of observations. Furthermore, this approach allows us to consider both heterogeneity and cross dependence between Eurozone countries.

[12]See http://www.cba.ua.edu/∼jlee/gauss.

### 3.3.2 Panel analysis

Historically, European countries have tied links for a long time, especially since the beginning of economic integration initiated after World War II. In this context of integration, European countries have shared common specificities—one of the tremendous example being the euro, and all the domains of monetary policy. However, despite this apparent homogeneity, some heterogeneity may persist due to distinct economic characteristics across members: European construction has been done by steps, and it widens gradually incorporating new countries often considered to be less integrated to Eurozone than the founding members. Therefore, some countries known as peripheral members (like Portugal, Spain, or Greece) exhibit lower levels of GDP per capita, prices, or productivity. Assuming that Germany is at the center of our Eurozone conceptualization, we can, as Braudel (1985), divide EMU into three sub-samples of countries:[13]

- the Core EMU, composed by Austria, Belgium, France, Italy, Luxembourg and the Netherlands;
- the Northern periphery, including Ireland and Finland;
- the Southern periphery made by Greece, Portugal, and Spain.

We assess potential price convergence dynamics across each sub-group using panel data unit root tests. To overcome the well-known problem of cross-sectional independence hypothesis among panel members (i.e. among the Eurozone countries), we apply second-generation panel unit root tests that relax this restrictive assumption required by first-generation tests.[14],[15] The Pesaran (2007) CIPS and the Choi (2002) tests are performed and the corresponding results are reported in Table 3.4, both tests considering the unit root as the null hypothesis.[16] The former test is based on Dickey–Fuller-type regressions augmented with the cross-section averages of lagged levels and first differences of the individual series. The later relies on an error-components panel model and removes the cross-section dependence

[13] An alternative classification would have been to retain the distinction between core and peripheral countries, the latter group being composed by Greece, Ireland, Portugal and Spain. Our choosing classification presents the advantage of distinguishing between Northern and Southern non-core countries.

[14] See Hurlin and Mignon (2006) and Hurlin (2010) for a detailed presentation of panel unit root tests.

[15] Economically, cross-section dependence can arise for several reasons, such as socioeconomic interactions and common factors. Cross correlation can also cause size distortions to first-generation panel tests. The cross-section dependence has been investigated using the CD test developed by Pesaran (2004) showing that such correlations exist in our samples of countries (results are available upon request to the authors).

[16] Matlab codes (Version 7.00) provided by Christophe Hurlin are used to implement these second-generation panel unit root tests (http://www.univ-orleans.fr/deg/masters/ESA/CH/churlin_R.htm).

by eliminating (i) individual effects using the Elliott et al. (1996) methodology (ERS), and (ii) the time trend effect by centering on the individual mean. For the sake of completeness, and as in the time-series context, we finally account for potential structural breaks in our panel setting. To this end, we rely on the Im, Lee and Tieslau (2010) LM-test which accounts for the possible existence of structural breaks in both the level and the trend of the series under study. While other panel tests accounting for breaks are available in the literature,[17] we retain the Im et al. (2010) test because (i) it specifically accounts for the usual nuisance parameter problem, (ii) it allows for the presence of breaks in both the level and the trend, and (iii) it does not depend on the size and location of the breaks—but only on their number—increasing its power compared to the other existing tests.

Results are relatively mixed and dependent on the test considered. The CIPS and Choi's tests frequently lead to different results. This difference may come from the way cross-sectional dependence is accounted for. Both tests are based on the one common factor approach. However, while Choi's test uses the orthogonalization procedure to deal with the cross-dependence problem, the CIPS test uses augmented cross-section average and therefore does not eliminate individual and time effects. In addition, while both tests consider one common factor, only the Choi's test allows for heterogeneous specification regarding the sensitivity of the factor, which is particularly relevant in the Eurozone macroeconomic context. Paying thus a particular attention to the Choi's approach, PPP relative to Germany is validated for both the whole sample and the core EMU in the three sub-periods. PPP also holds for Southern periphery during the first two periods, but not after the launch of the euro. Regarding Northern periphery, there are strong evidences that PPP is violated for each sub-period. Finally, regarding results in Table 3.5, the third-generation Im et al. (2010) test always fails to reject the null hypothesis, going against the validity of the PPP hypothesis. On the whole, our results put forward that price dynamics is heterogeneous between EMU members.

To complement these findings, we estimate the half-life of deviations from PPP for subgroups as well as individual countries. To this end, we use the PMG estimator developed by Pesaran, Smith and Shin (1999). This procedure consists in estimating a panel error correction model where homogeneity accross members is imposed for the long-run relationship,[18] while heterogeneity is allowed in the short-run dynamics and error correction

[17] See Carrion-i Silvestre et al. (2005), Harris et al. (2005), and Chan and Pauwels (2009) among others.
[18] This hypothesis can be tested using an Hausman-type test.

Table 3.4: **Second-generation panel unit root tests (p-values)**

| | Whole sample | Core | Northern Periphery | Southern Periphery |
|---|---|---|---|---|
| 1970.01-1987.06 | | | | |
| Specification | C | C | T+C | C |
| CIPS | 0.41 | 0.95 | 0.7 | 0.42 |
| Choi | | | | |
| $P_m$ | 0*** | 0*** | 0.79 | 0*** |
| $Z$ | 0*** | 0*** | 0.71 | 0.21 |
| $L^*$ | 0*** | 0*** | 0.69 | 0*** |
| 1987.07-1998.12 | | | | |
| Specification | C | C | T+C | C |
| CIPS | 0.25 | 0.01*** | 0.99 | 0.99 |
| Choi | | | | |
| $P_m$ | 0*** | 0*** | 0.73 | 0.01*** |
| $Z$ | 0*** | 0*** | 0*** | 0.02** |
| $L^*$ | 0*** | 0*** | 0.59 | 0.02** |
| 1999.01-2011.07 | | | | |
| Specification | C | T+C | T+C | T+C |
| CIPS | 0.84 | 0.5 | 0.99 | 0.24 |
| Choi | | | | |
| $P_m$ | 0.01*** | 0*** | 0.7 | 0.85 |
| $Z$ | 0.01*** | 0*** | 0.56 | 0.91 |
| $L^*$ | 0.01*** | 0*** | 0.55 | 0.9 |

* (resp **, ***): rejection of the unit root null hypothesis at the 10% (resp. 5%, 1%) significance level. C (resp T+C) denotes model with individual effects (resp. individual effects and time trends). (a) For the CIPS test, all statistics are based on univariate AR(p) specifications with $p \leq 8$. (b) For the Choi's test, the optimal lag orders in the individual ERS statistics (Elliott, Rothenberg and Stock, 1996) for each series are determined with $p \leq 8$; under the null hypothesis the Choi's statistics are standard Normal when T and N converge jointly to infinity.

Table 3.5: **Im, Lee and Tieslau (2010) test results**

| | Whole sample | Core | Northern Periphery | Southern Periphery |
|---|---|---|---|---|
| Test stat. | 7.56 | 7.63 | -1.24 | 5.06 |

For Northern countries the reported statistic corresponds to the no cross-dependence case where time effects have been included.

Table 3.6: **Pooled Mean Group estimates of the error-correction term and estimated half-lives**

| | Whole sample | Core | Northern Periphery | Southern Periphery |
|---|---|---|---|---|
| 1970.01-1987.06 | | | | |
| $\phi$ | -0.069 | -0.063 | No | -0.112 |
| Half-life | 9.69 | 10.65 | cointegration | 5.83 |
| 1987.07-1998.12 | | | | |
| $\phi$ | -0.109 | -0.157 | No | -0.067 |
| Half-life | 6 | 4.06 | cointegration | 9.99 |
| 1999.01-2011.07 | | | | |
| $\phi$ | -0.055 | -0.067 | No | No |
| Half-life | 12.25 | 9.99 | cointegration | cointegration |

$\phi$ denotes the error-correction term estimated by the PMG method. Half-lives are expressed in months.

mechanisms. It combines two well-known procedures used in panel data: (i) the totally heterogeneous "mean group estimate", that consists in estimating separately $N$ individuals regressions and averaging the group specific coefficients; and (ii) the homogeneous "pooled estimator", in which only the intercept is authorized to differ across Eurozone members.

Tables 3.6 and 3.7 report the PMG estimates of the error-correction term and the corresponding half lives. As shown in Table 3.6, the period corresponding to the implementation of the Single Act is the one for which half lives are the smallest for the whole sample (about 6 months) and for the Core EMU (about 4 months). This is in line with the literature arguing that the Single Act has allowed to fully remove the remaining trade barriers (Engel and Rogers (2004)). This may also be linked to the requirements of nominal convergence

Table 3.7: **Pooled Mean Group estimates of the error-correction term and estimated half-lives**

| Countries | | 1970.01-1987.06 | 1987.07-1998.12 | 1999.01-2011.07 |
|---|---|---|---|---|
| Austria | $\phi$ | -0.006 | -0.37 | -0.05 |
| | Half-life | 115 | 1.5 | 13.51 |
| Belgium | $\phi$ | -0.08 | -0.14 | -0.01 |
| | Half-life | 8.31 | 4.59 | 68.97 |
| France | $\phi$ | -0.13 | -0.05 | -0.15 |
| | Half-life | 4.97 | 13.51 | 4.26 |
| Italy | $\phi$ | -0.02 | -0.03 | -0.02 |
| | Half-life | 34.31 | 22.75 | 34.31 |
| Luxembourg | $\phi$ | -0.07 | -0.19 | -0.08 |
| | Half-life | 9.55 | 3.29 | 8.31 |
| Netherlands | $\phi$ | -0.04 | -0.13 | -0.07 |
| | Half-life | 16.38 | 4.98 | 9.55 |
| Greece | $\phi$ | -0.15 | -0.08 | No |
| | Half-life | 4.26 | 8.31 | cointegration |
| Portugal | $\phi$ | -0.11 | -0.05 | No |
| | Half-life | 5.95 | 13.51 | cointegration |
| Spain | $\phi$ | -0.07 | -0.04 | No |
| | Half-life | 9.55 | 16.98 | cointegration |

$\phi$ denotes the error-correction term estimated by the PMG method. Half-lives are expressed in months.

due to the entry into the monetary union. The introduction of the euro, that was expected to accentuate this mechanism by improving market information, lowering trade costs and reducing uncertainty, seems to have had little effects, since half lives have increased (12 months for the entire sample, 10 for the Core EMU)—a finding that may be related to weaker ajustment mechanisms within the monetary union. Turning to Southern periphery, half lives are very small in the first period (about 6 months), but increase in the second (10 months). This increase may be obviously linked to the EMS crisis and, especially, to the huge nominal devaluation encountered by the Spanish and Portuguese currencies following the enlargement of the fluctuation margins within the monetary union.

Regarding individual countries (Table 3.7), heterogeneity across members is even more marked. Inside the Core, and during the first period, France exhibits the lowest half life, about 5 months, while it is about 34 months in Italy and 115 in Austria. During the second period, the differences tend to diminish, but the launch of the euro triggered a raise of gaps. One of the worrying result is the half life of Belgium in the third period, being about 68 months. Such a value may indicate that this country is running out the cointegration path. Regarding the Southern group, departures from PPP have increased between the first and the second period, but they are relatively homogeneous between countries.

## 3.4 Analysis and scope of the results

Our results put forward that price dynamics is not homogeneous (i) in time, and (ii) between European countries. Here, we aim at identifying the reasons of this heterogeneity across members, a fact that is highly relevant given that heterogeneity in price dynamics is at the roots of the sovereign debt crisis that EMU is experiencing.

### 3.4.1 Heterogeneity of price dynamics as a consequence of structural economic heterogeneity

One of the reasons explaining the differences in price dynamics is the Balassa-Samuelson catching-up effect, that entails an elevation of the aggregate price levels in the low-productivity level countries. It can be considered as an asymmetric shock since the high-level productivity countries are expected to experience price stability. One of the proxies often used to model this phenomenon is the relative GDP PPP per capita.

Table 3.8: **GDP PPP per capita relative to Germany in percent between 1970 and 2010**

| Countries | 1970 | 1987 | 1998 | 2007 | 2010 |
|---|---|---|---|---|---|
| Austria | 94.12 | 99.95 | 102.8 | 107.2 | 105.8 |
| Belgium | 96.77 | 97.22 | 98.38 | 100.4 | 98.27 |
| Finland | 80.93 | 90.26 | 86.73 | 100.2 | 94.93 |
| France | 94.96 | 94.73 | 92.38 | 91.53 | 88.74 |
| Greece | 74.18 | 68.5 | 65.5 | 78.6 | 72.49 |
| Ireland | 62.09 | 65.74 | 98.55 | 122.9 | 107.65 |
| Italy | 86.08 | 92.9 | 91.14 | 86.11 | 80 |
| Luxembourg | 145.3 | 150.3 | 184.5 | 221.95 | 205 |
| Netherlands | 112.6 | 102.07 | 108.5 | 112.5 | 110.7 |
| Portugal | 52.98 | 57.62 | 68.01 | 65.84 | 64.86 |
| Spain | 74.92 | 74.21 | 80.03 | 85.39 | 80.6 |

Authors' calculation on the basis of OECD data.

Table 3.8 reports GDP PPP per capita relative to Germany. The 2007 value is shown to assess the effects of "subprimes" and hence "sovereign debt" crises. Regarding Southern Europe, the situations are somewhat mixed. Portugal has markedly reduced the gap relative to Germany before 1999, however it is not totally fulfilled and differences are still consequent. Moreover, the reduction is definitely stopped after 1999 with the launch of the euro. Instead, Greece seems to have experienced a catching-up after the implementation of the single currency. As Portugal, the departure is not eliminated. Finally, Spain appears to have converged to German GDP per capita all over the period. Balassa-Samuelson catching up is then a satisfactory explanation for the PPP violation for Greece and Spain, but not for Portugal. Regarding Northern periphery, the Balassa-Samuelson catching up is at play in Ireland and Finland for the whole period. Turning to the Core, interesting insights stand out. GDPs per capita relative to Germany have been relatively stable between periods (unless Luxembourg, that can be considered as an outlier), providing a general background for the results found in Section 3.3.2. The elevated half-lives obtained for Italy during all the periods can be explained by the size of the GDP gap (that is relatively higher than for the other countries belonging to the Core) relative to Germany.

Nonetheless, Balassa-Samuelson catching up is not the unique reason of asymmetric shock appearance. The nominal exchange rate level relative to the rest of the world can also constitute a factor that can lead to divergences in price dynamics. In other words, can EMU members compete with low wage countries with a strong currency if they are specialized in low technology products? Since the competitiveness of these products is highly sensitive to costs, members specialized in low technology have to pressure downward their wages, and also their price to recover competitiveness relative to low wage countries. Members that are specialized in high technology do not experience these constraints since their products are less sensitive to costs. Two different price dynamics are then at play: one pressured downward, the other unconstrained. Since the wages are not likely to decrease, members specialized in low technology will face a dramatic loss of competitiveness if they do not go up market.

We try to control for that effect by constructing a simple index of technological specialization on the basis of the revealed comparative advantages for the CITI manufacturing indicator (see Appendix for the construction of the index). Table 3.9 reports the technological specialization for each country during the periods 1987-1998 and 1999-2009. Four categories of countries can be distinguished:

- Our benchmark country, Germany is specialized in industries with high technological contents: its products are innovative, or positioned on the high quality segment, which allows it to discriminate its prices.
- Austria, Finland, France, and the Netherlands own at equal shares high and medium technology industries. They have a lower market power than Germany, even if it remains substantial.
- Belgium, Ireland, Italy and Spain are mainly specialized in medium-technology sectors, and have very few high-tech industries. Moreover, low-technology sectors represent an important part of specialization in Spain and Italy.
- Greece and Portugal are mostly specialized in low-technology industries, facing a strong competition in prices.

The heterogeneity of specialization supplemented by rigidities in wage decrease, may explain the non-convergence of Southern countries, especially Portugal, and also the elevated half-lives of Belgium and Italy: without the possibility of decreasing wages (and hence

Table 3.9: **Technological specialization in 1987-1998 and 1999-2009**

| | Specialization | |
|---|---|---|
| Period | 87-98 | 99-09 |
| Austria | high technology | high technology |
| Belgium | medium technology | medium technology |
| Finland | high technology | high technology |
| France | high technology | high technology |
| Germany | superior technology | superior technology |
| Greece | low technology | low technology |
| Ireland | medium technology | medium technology |
| Italy | medium technology | medium technology |
| Luxembourg | NA | NA |
| Netherlands | high technology | high technology |
| Portugal | low technology | low technology |
| Spain | medium technology | medium technology |

Source : OCDE. NA : non available.

prices), a strong currency induces a loss of competitiveness that translates into imbalances in goods markets, and finally a violation of PPP.

### 3.4.2 Scope of the results

To our best knowledge, with the exception of Cecchetti et al. (2002), no study exists on the PPP deviation inside a monetary area. Cecchetti et al. (2002) have tested price index convergence among US cities using first generation panel unit root tests. Comparing our results with theirs may be interesting because the US is a long-lived monetary area, with strong political links and where economic integration is entire. Although Cecchetti et al. (2002) find, as we do, price convergence between US cities (i.e. validation of the PPP hypothesis), their half-lives are far higher than ours. They are comprised between eight and nine years for their whole sample (19 cities on the 1918 to 1995 period), and about eight years for the more recent period (1976-1995). Such results would mean that EMU is more integrated than the US, which is unlikely. The more plausible explanation lies in the data used as well as the econometric techniques that have been implemented. Cecchetti et al. (2002) consider price indexes instead of price levels, which is not appropriate for testing absolute PPP. Moreover, first generation panel unit root tests may have been too restrictive to assess price convergence since they assume homogeneity between members,

an hypothesis that is not verified as seen in the previous section.

The recent literature on OCA has mainly devoted attention to cyclical rather than structural homogeneity of the countries considered. On one hand, an empirical strand tried to assess the correlation of business cycles and the symmetry of shocks through VARs (see Bayoumi and Eichengreen 1993, and 1996 among others). On the other hand, a theoretical strand focused on the means of rendering business cycles and shocks more symmetric (the endogenous criteria literature, pioneered by Frankel and Rose (1998)). Our approach revives the pioneering phase of OCA literature (Mundell (1961), McKinnon (1963) and Kenen (1969)) that emphasized on the structural similarities of currency union members, and stresses that these criteria may be the most important to achieved the optimality, or at least the viability, of a monetary union. Following Juselius (1995), linking PPP (goods market) and uncovered interest parity (capital market) conditions, it is possible to understand through price dynamics why structural heterogeneity among members of a currency union is a problem. In the absence of trade barriers as well as exchange rate adjustments, a violation of PPP (such a Balassa-Samuelson catching-up, but not only) leads immediately to goods market imbalances (trade deficits) that have to be compensated by capital inflows. This creates asymmetric debt emissions between members that results *in fine* (through long interest rates and default probability differentials) in sovereign debt crisis from part of the members. This mechanism seems to fit the troubles EMU is experiencing.

## 3.5 Conclusion

This chapter aims at investigating whether price dynamics is homogeneous across the Eurozone countries. This question if of particular interest in the current debt crisis context, since heterogeneity in price dynamics may be one of the causes of the turmoil. Relying on monthly data over the January 1970-July 2011 period, we test for the absolute purchasing power parity (PPP) hypothesis through the implementation of second-generation panel unit root and cointegration tests. Our results show that price dynamics is heterogeneous depending on both the time period and the considered group of countries. More specifically, while PPP is validated for the core EMU countries, this hypothesis does not hold for Northern peripheral countries such as Ireland and Finland which experienced a Balassa-Samuelson effect. Turning to the Southern countries, namely Greece, Portugal and Spain, PPP is observed only before the launch of the euro. This violation of the PPP on

the recent period may be explained by a catching-up phenomenon, as well as the countries' technological specialization pattern.

Our findings of heterogeneous price dynamics put forward the issues of current account imbalances inside EMU, and the sovereign debt crisis. The importance attached to price dynamics by European authorities (as well as theory) is twofold. On the one hand, price dynamics conditions the efficiency of the monetary policy. On the other hand, it raises concerns about the competitiveness differentials inside the area, and hence the viability of the currency union. Heterogeneity in price dynamics that is not exclusively due to catching-up effects, as it seems to be supported by chapters 2 and 3 in the case of some Eurozone countries, results in a loss of competitiveness that entails "bad" external imbalances, that are at the roots of sovereign debt crisis.

In the following chapter, we try to document those links and find both a theoretical and empirical model that is able to link the price dynamics to the raise of interest rates differentials in the Euro area.

## 3.6 Appendix

The definition of the technological specialization is based on the revealed comparative advantages for trade micro-indicators in the manufacturing category (CITI database, available on OECD). Table 3.10 reports the sector associated to each number.

On the basis of the analysis of these indexes at a disaggregated level, we consider the following typology:

- Specialization in low technology sectors: indexes 15 to 21.
- Specialization in medium technology sectors: indexes 22 to 28 and 36.
- Specialization in high technology sectors: indexes 29 to 35.

Note that index 23 has a high technology industry, that of nuclear, in which only France is specialized. Accordingly, we consider that for France index 23 testifies a high technology specialization. In Table 3.11, we report for the two sub-periods the sectors in which countries are specialized.

Figure 3.1: **Price level series (in logarithms)**

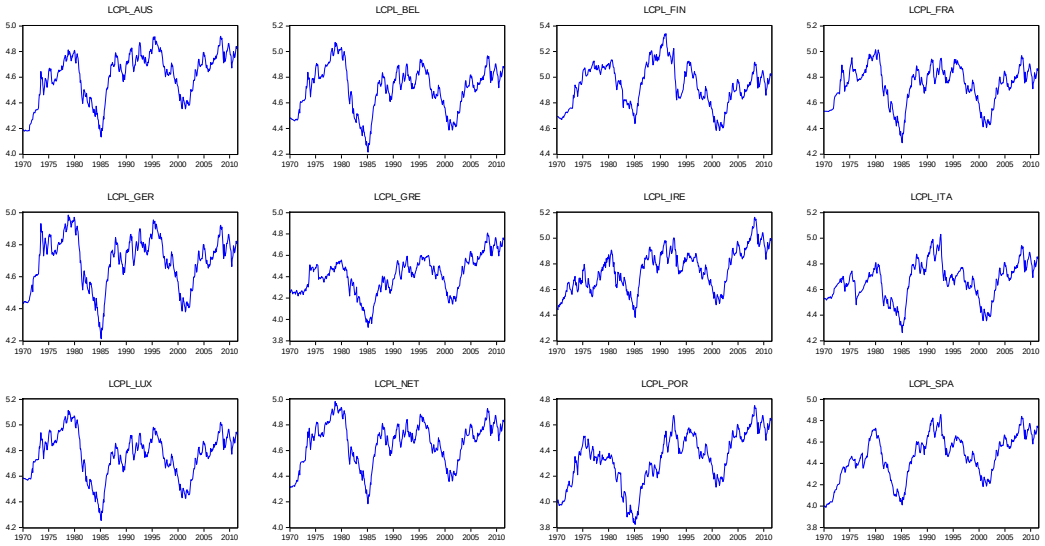


Table 3.10: **Definition of CITI indexes**

| Index | Definition |
|---|---|
| 15 | food products and beverages |
| 16 | tobacco products |
| 17 | textiles |
| 18 | wearing apparel ; dressing and dyeing of fur |
| 19 | dressing of leather ; luggage |
| 20 | woods and products of wood and cork (except furnitures) |
| 21 | paper and paper products |
| 22 | publishing, printing and reproduction of recorded media |
| 23 | coke, refined petroleum products and nuclear fuel |
| 24 | chemical products |
| 25 | rubber and plastic products |
| 26 | non metallic mineral products |
| 27 | basic metals |
| 28 | fabricated metal products (except machinery and equipments) |
| 29 | machinery and equipment n.e.c. |
| 30 | office, accounting and computing machinery |
| 31 | electrical machinery and apparatus n.e.c. |
| 32 | radio and television communication equipment |
| 33 | medical, precision and optical instruments |
| 34 | motor vehicles, trailers and semi-trailers |
| 35 | other transport equipment |
| 36 | furniture, manufacturing n.e.c. |

Source : CITI, OECD.

Table 3.11: **Specialization of Eurozone members based on comparative revealed advantages**

| | Specialization | |
|---|---|---|
| Period | 1987-1998 | 1999-2009 |
| Austria | 17, 19, 20, 21, 22, 25, 27, 28, 29, 31, 34, 36 | 15, 16, 19, 20, 21, 22, 25, 26, 27, 28, 29, 31, 34, 36 |
| Belgium | 15, 17, 23, 24, 25, 26, 27, 34 | 15, 17, 21, 23, 24, 25, 26, 27, 34 |
| Finland | 20, 21, 22, 27, 28, 29, 31, 32, 35, 36 | 20, 21, 22, 27, 28, 29, 31, 32, 35, 36 |
| France | 15, 22, 23, 24, 25, 26, 28, 31, 34, 35 | 15, 21, 22, 23, 24, 25, 26, 28, 29, 31, 33, 34, 35 |
| Germany | 21, 24, 25, 26, 29, 31, 33, 34, 35 | 16, 21, 24, 25, 29, 31, 33, 34, 35 |
| Greece | 15, 16, 17, 18, 26, 27 | 15, 16, 17, 18, 22, 25, 26, 27, 28 |
| Ireland | 15, 22, 24, 30 | 15, 22, 24, 30 |
| Italy | 17, 18, 19, 26, 28, 29 | 15, 17, 18, 19, 21, 26, 28, 29 |
| Netherlands | 16, 22, 23, 24, 25, 30, 33 | 16, 22, 23, 24, 30, 33 |
| Portugal | 15, 17, 18, 19, 20, 21, 26, 28, 31, 34, 36 | 15, 16, 17, 18, 19, 20, 21, 23, 26, 28, 31, 34, 36 |
| Spain | 15, 19, 23, 25, 26, 27, 28, 34 | 15, 19, 21, 23, 24, 25, 26, 27, 28, 34 |

Source: classification established by the authors on the basis of CITI and OECD data.

# Chapter 4

# Is the European debt crisis a mere balance of payments crisis?

## 4.1 Introduction

Despite the vast literature on Optimum Currency Areas (OCA) that emerged in the line of Mundell's (1961) seminal paper, there is still a long way to go in order to fully understand all the mechanisms, and apprehend all the stakes, raised by the formation of a currency union. The current European debt crisis constitutes an example of such complexity. What was seen at the very beginning as a mere slippage in public finances due to the lack of stringency from peripheral countries accounting for less than 10% of the Eurozone GDP, is turning now into a severe sovereign crisis challenging the grounds of a political and economical construction that took more than half a century to build.

Since it is always difficult to analyze a crisis on the spot, the likely roots of interest rates differentials in EMU are still an open question. On the one hand, structural economic factors, such as the high debt ratios relative to GDP, the large deficits and the low growth expectations, have triggered the mistrust of markets. On the other hand, political factors, like the fuzzy management of EMU, have strengthen this mistrust. One may however wonder to which extent these former economic factors are not second-round effects traducing more global structural imbalances in the specific context of currency areas. In other words, the sovereign crisis may actually be a typical form of balance of payments crisis when parities are irrevocably fixed.

Much before the general model developed by Krugman (1979) that defines the balance of payments crisis as the inability for a government to defend a fixed parity due to the constrains of its actions, the pioneering theorists of OCA (Mundell, 1961; McKinnon, 1963; Kenen, 1969; Fleming, 1971) have widely discussed the problem inside the single currency framework. According to them, money is an economic tool that plays a central part in the absorption of economic disequilibria (such as loss of competitiveness, unemployment) for an independent nation. However, when several countries decide to relinquish their own currency in order to form a monetary union, they also drop the chance to carry discretionary monetary policies to solve possible internal but also external imbalances. This strand of literature highlights that there is a "trade-off" between the homogeneity of the participating countries and the existence of real adjustment mechanisms inside the zone. Whether the union is made of highly similar members so that asymmetric shocks (such as imbalances between members) are avoided, either there are enough real adjustments mechanisms between members that allow to cope with asymmetric shocks.

When there is a lack of homogeneity and real adjustments, monetary union is non-optimal: the fixed exchange rate regime that also implies a "one-size-fits-all" monetary policy is not the adequate regime to ensure both internal and external equilibrium. EMU seems suffering these two shortcomings. First, there is a strong heterogeneity in terms of income per capita, specialization patterns, or economic institutions (Carlin, 2011). Second, labor mobility between participants, that constitutes the principal mechanism of real adjustment, is very low, lower than in long-lived currency unions such the United States (OECD, 1999). Hence EMU members may be subject to the occurrence of external disequilibriums relative to their currency partners (*i.e.* EMU may experience internal disequilibriums).

While there exists a wide literature dealing with external imbalances, especially concerning the US (Cline, 2005 and 2009), very few studies pay a special attention to the phenomenon inside EMU. Relying on the approach introduced by Chinn and Prasad (2003), that consists in estimating current accounts through a set of economic fundamentals, Barnes et al. (2010) evidence that the surpluses as well as the deficits respectively exhibited by Germany and the Netherlands on one hand, and Greece, Portugal and Spain on the other hand, are greater than those suggested by their model during the 2004-2008 period. This supports the existence of external imbalances relative to the fundamental equilibrium. Based on the same methodology, Jaumotte and Sdosriwiboon (2010) reach similar results for Southern periphery in 2008.

In the context of price convergence inside EMU, Guerreiro and Mignon (2011), and Guerreiro et al. (2012) adopt a different approach: they apprehend the issue of external equilibriums by testing the PPP hypothesis for EMU countries with Germany as numeraire. As stated by Juselius (2003), a violation of PPP (Purchasing Power Parity) "*signals an imbalance in the goods market, which in the absence of trade barriers is likely to results in trade deficits*". Hence in a monetary union framework, a non respect of PPP can be assimilated to an external imbalance. Relying on the estimation of nonlinear threshold models, Guerreiro and Mignon (2011) find evidences of price convergence (PPP validation) for each member, except Finland, during the 1970-2011 period. The convergence speeds, when controlled for a set of competitiveness indicators, appear however too high for Greece and Portugal, suggesting a loss of competitiveness for these two countries relative to Germany. Guerreiro et al. (2012) tackle the problem by using panels. They constitute four

groups – EMU as a whole, its core, its Northern periphery, its Southern periphery – and test the PPP hypothesis on three sub-periods (1970-1987, 1987-1998, 1999-2011). If PPP is validated for the whole EMU and for the core countries for each period, it is violated for Northern periphery regardless the period, and for Southern periphery during the last period. Here again some asymmetries concerning external imbalances are pointed out.

The aim of this chapter is to go further than the previous literature by linking the external disequilibrium to the surge of the interest rates differentials, demonstrating that i) the sovereign debt crisis finds its deep roots in real imbalances, and ii) this debt crisis is the special form taken by a balance of payments crisis when parities are irrevocably fixed. To this end, we rely on the **CHEER** (**C**apital en**H**anced **E**quilibrium **E**xchange **R**ate) approach introduced by Juselius (1991, 1995), Johansen and Juselius (1992), Camarero and Tamarit (1996), and MacDonald and Marsh (1997, 2004), that allows to test jointly the international parities, PPP and UIP (Uncovered Interest Parity), through a cointegrated VAR.

The remainder of the chapter is organized as follows: section 4.2 presents the theoretical framework. Section 4.3, describes the economic methodology and the data. Section 4.4 is dedicated to results and their corresponding comments. Finally, section 4.5 concludes the chapter.

## 4.2 Theoretical backgrounds

### 4.2.1 Identifying external imbalances and linking them to interest rates differentials

To emphasize how external disequilibriums may induce a raise in the interest rates differentials, we adopt the CHEER approach that links the goods market, modeled by PPP, to the capital market, modeled by UIP. This method has been introduced by Juselius (1991, 1995) in order to face the poor empirical support for PPP as well as for UIP. According to her, supplementing PPP by UIP extends the analysis because statistically, it improves the specification of the sampling distribution of the data, and theoretically, it takes into account the eventual interactions between the goods and the capital markets. MacDonald

and Marsh (1997) reinforce the theoretical background by showing that such a framework captures the Casselian view of PPP.

Following Guerreiro and Mignon (2011), and Guerreiro et al. (2012), we consider that PPP theory is a fair concept to identify external imbalances. For Breuer (1994), the PPP concept developed by Cassel (1922) implies that there are some restoring forces driving the nominal exchange rate between two countries to a ratio that ensures the equalization of their real exchange rates. This ratio warrants the same purchasing power of the two currencies when these last are converted into the same measure unit. Formally we get (in the absolute form of PPP):

$$e_t = p_t - p_t^* \tag{4.1}$$

where $e_t$ is the log of the spot exchange rate, and $p_t$ and $p_t^*$ respectively denote the log of the domestic and foreign price levels. However, and excluding the assumptions relative to the similarity of tastes and technologies, strong restrictions are required for PPP being validated. The most important are surely the absence of trade barriers preventing international market clearing, and also the external balance of economies.[1] Indeed when there are trade deficits or fiscal imbalances, deviations to PPP occur. Reversing the reasoning, a violation of PPP indicates that one or both these conditions are not fulfilled.

UIP is the interplay of PPP on the capital market. This theory is often used by monetary models to determine the exchange rates, but, unlike PPP, it is a forward rather than a backward market clearing mechanism, and adjustments are thought to be much faster than in goods market (Camarero and Tamarit, 1996). UIP states that the interest differential between two countries is equal to the change in parities expected between two countries as described in Equation (4.2):

$$E_t(\Delta e_{t+1}) = i_t - i_t^* \tag{4.2}$$

where $E_t(\Delta e_{t+1})$ is the expected exchange-rate change for $t+1$, $i_t$ and $i_t^*$ are respectively

[1]Note that Cassel advances other conditions as the absence of speculation or the non intervention of Central Banks.

the domestic and foreign interest rates. According to Juselius (1995), PPP and UIP can be linked through the expected exchange rate. Turning back to PPP, when the forecast horizon grows, the principal determinant of exchange rates' expectations is the PPP deviation:

$$E_t(e_{t+1}) = p_t - p_t^* \tag{4.3}$$

with $E_t(e_{t+1})$ the expected exchange rate. Then, plugging (4.3) into (4.2) it comes:

$$i_t - i_t^* = p_t - p_t^* - e_t \tag{4.4}$$

Equation (4.4), which links the capital market to the goods market, is an enhanced version of PPP and UIP because it allows disequilibriums on goods market to be balanced by disequilibriums on capital market and *vise versa*.

### 4.2.2 The special case of monetary unions

If we assume now that the two countries under study form a monetary union, two new aspects affecting the form and the interpretation of our relations have to be highlighted. The first one is the absence of trade barriers. As theorized by Balassa (1961), a monetary union is the final stage of an economic integration. As such it intervenes when trade barriers are removed. It is important when interpreting PPP: inside a currency area, a violation of PPP traduces in fact the presence of external imbalances between two participating members. The second feature is the fixity of parities. It implies that the nominal exchange rate (in log) $e_t$ is equal to 0, which will modify both PPP and UIP relations.

If we look at PPP, Equation (4.1) becomes:

$$p_t = p_t^* \tag{4.5}$$

Moreover, a first interesting insight concerning PPP and monetary unions comes from Equation (4.3). In a currency area, the expected exchange rate $E_t(e_{t+1})$ has to be equal to zero, because of the fixed regime. Nonetheless, when PPP is not validated, $E_t(e_{t+1})$ is different from zero, which indicates that the survival of monetary union is questioned: the

external disequilibriums between the two countries are pushing the nominal exchange rate away from the value determined by the monetary commitment.

The UIP relation is also amended. Within a monetary union, short-term interest rates are the same for all members since they are set by a federal Central Bank. However, long-term interest rates may differ as long as the monetary union is not supplemented by a fiscal union, as in EMU. The absence of mutual bonds (*i.e.*"federal" bonds) forces the members to borrow in their own name, allowing long-run differentials to diverge. We can then rewrite UIP as:

$$E_t(\Delta e_{t+1}) = i_t^l - i_t^{l^*} \tag{4.6}$$

where $i_t^l - i_t^{l^*}$ is the long-term interest rate differential. Here, a second interesting insight appears. As for PPP, a non null interest differential induces that the expected change of the nominal exchange rate $E_t(\Delta e_{t+1})$ is also non null. This indicates that the sustainability of monetary commitment is challenged, and that monetary union is likely to break up. Indeed, when parities are irrevocably fixed, $E_t(\Delta e_{t+1})$, that represents the confidence of investors in currency union survival, has to be equal to zero.

Accounting simultaneously for goods and capital markets allows to mitigate the outcomes of separate PPP and UIP predictions. When linking both theories inside a monetary union framework, we get:

$$i_t^l - i_t^{l^*} = (p_t - p_t^*) \tag{4.7}$$

Equation (4.7) shows that the adjustments in a currency union that can not be made through exchange rates are realized thanks to interactions between goods and capital markets. Goods market imbalances (external imbalances) are compensated by the raise of interest differentials in order to keep the nominal exchange rate constant and equal to zero. Hence, theoretically a currency union can be perpetual even if there are imbalances between its members, providing that a raise in the interest differentials is accepted. This situation is not likely because the raise of interest rates will aggravate the imbalances (the snowball effect) until one or more members run into bankrupt. Two main results are pointed out by our modified CHEER model. First, booms of interest differentials inside a monetary area can be assimilated to a balance of payments crisis because they are due

to external imbalances between members, which goes in our direction. Second, these latter are not sustainable on the long run: whether a resorption is achieved inside the zone through real adjustments (Mundell, 1961), whether it takes place outside the union by a break of parities.

## 4.3 Econometrics of the CHEER

### 4.3.1 Econometric transcription of the theoretical model

Despite the useful theoretical information carried by Equations (4.1) to (4.7), these latter are not directly tractable to test separately or simultaneously PPP and UIP. The most popular (and surely the most reliable) way of assessing the validity of international parities is to rely on the cointegrating approach, which is particularly suitable regarding the time horizon at play (long run).

Paying attention to Equation (4.5), the transcription of PPP becomes:

$$p_t - p_t^* \sim I(0) \tag{4.8}$$

A stationary price differential indicates that domestic, $p$, and foreign, $p^*$ prices are cointegrated, and hence that absolute PPP holds. On the short run, some deviations between the two prices may occur, however, on the long run the prices follow the same behavior. When price differentials are integrated at the first order, purchasing power of money does not hold anymore. *Ceteris paribus*, it signals that the country where purchasing power deteriorates faces a loss of competitiveness. The latter results, in absence of trade impediments, in trade deficits and external imbalances. Turning to Equation (4.6), UIP is apprehended through:

$$i_t^l - i_t^{l^*} \sim I(0) \tag{4.9}$$

Again, stationary interest rates differentials mean that it might be divergences in interest rates on the short run, nonetheless there also are restoring forces on the long run that push interest rates to converge.

As already emphasized, the CHEER modeling allows to relax the individual assumptions of PPP and UIP holding in favor of joint validity. Formally, we get:

$$p_t - p_t^* \sim I(1) \text{ and } i_t^l - i_t^{l^*} \sim I(1)$$

$$\text{but, } i_t^l - i_t^{l^*} - p_t + p_t^* \sim I(0) \tag{4.10}$$

Equation (4.10) is central to our analysis, because it illustrates that international parities deviations might be linked through a long-run (cointegrating) relationship. It is an interesting characteristic since it offers the possibility of establishing the nature of interactions, especially the direction of causality. Thus it enables us to ascertain if interest differentials are produced by a non-respect of PPP, in other words, if the European debt crisis is a balance of payments crisis.

### 4.3.2 Econometric methods and restrictions formulation

We tackle the possible relationships stated by Equation (4.10) thanks to the vector autoregressive (VAR) model, as suggested by the former literature on CHEER. Since non stationarity of our variables is likely[2], as underlined in section 4.3.1, we rely on the cointegrated VAR (CVAR) specified as follows:

$$\Delta x_t = \sum_{i=1}^{s+1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-1} + \Psi D_t + \epsilon_t \tag{4.11}$$

where $x_t$ is the vector containing our variables, $x_t = (i_t^l, i_t^{l^*}, p_t, p_t^*)'$, $D_t$ contains the deterministic components (constant, trend, and dummies), and $\epsilon_t$ is an error term whose mean is zero, and that is homoscedastic and non-autocorrelated. Given that $\Delta x_t \sim I(0)$ and $x_{t-1} \sim I(1)$, $\Pi$ is a rank reduced parameter matrix ($rank(\Pi) = r$ and $r < n$, $n$ denoting the number of variables) that allows to balance the system. It represents the long-run responses matrix (MacDonald and Marsh, 2004). More formally, $\Pi = \alpha\beta'$, where $\beta'$ is the matrix containing the cointegrating vectors, and $\alpha$ that containing the loading parameters associated to each cointegrating vector (in other words, the adjustment matrix).

A valuable ability of the cointegrated VAR models lies in the possibility of implement-

[2]Integration rank of variables will be tested in section 4.4.1

Table 4.1: **Restrictions, economic interpretation and sensitivity implications**

| Hypothesis | Restrictions on $\beta$ | Economic interpretation | Sensitivity |
|---|---|---|---|
| A | $\beta$=[1,-1,-1,1] | Unitary UIP and PPP | Strong sensitivity since elasticity is equal to 1 |
| B | $\beta$=[$\gamma$,-$\gamma$,-1,1] | Parity UIP and unitary PPP | Semi-strong sensitivity if $\|\gamma\|>1$, elasticity is lower than 1 |
| C | $\beta$=[$\delta$,-$\sigma$,-1,1] | Non-parity UIP and unitary PPP | Non proportional relation, weak sensitivity |

Note: $\beta = [i_t^l, i_t^{l^*}, p_t, p_t^*]$. Causality is assumed to run from goods market to the capital market.

ing a battery of tests. In addition to rank and causality tests that respectively provide answers to the number of relationships and their directions, CVARs grant the fulfillment of significance tests through restrictions imposition on the cointegrating space, Π. When applied on $\beta$, the restrictions are intended to check the conformity of the results found with the theoretical predictions. In our case, they not only license to appraise the theory, but also the essence of interplay between PPP and UIP: significance tests enable to investigate the values of cointegrating vectors, and hence the sensitiveness existing between the international parities. In Equation (4.10), we restricted all the coefficients to 1, which perfectly frames with pure (or unitary) PPP and UIP. However, this hypothesis may be too strong, which leads us to construct a typology of weaker assumptions. Since we are interested in demonstrating that interest differentials are caused in a monetary union by PPP deviations, we keep pure form of PPP in all the hypotheses. We report them on Table 4.1 with their corresponding theoretical meaning and the implication on sensitivity. These three models constitute the basis on which we draw our empirical analysis on the linkage of international parities.

Restrictions may also be placed on the loading parameters, $\alpha$. Doing so amounts to examine the weak exogeneity of variables. They are also useful to determine short-run dynamics of stationary relationships. After ensuring that likelihood ratio tests validate the $\beta$ restrictions, imposing restrictions on $\alpha$ permit to discover the channel(s) through which deviations of PPP and UIP are reduced.[3]

[3]As similar approach is handled by Akram (2006) for PPP in the case of Norway.

### 4.3.3 Data

Literature dealing with PPP and CHEER has largely used CPIs as proxies of price levels, mainly because of the lack of available data. However, CPIs are unusable since they do not account for price level differentials between countries: they only depict the evolution of prices. To overcome this issue, we take over the methodology introduced by Allington et al. (2005) and improved by Guerreiro and Mignon (2011) and Guerreiro et al. (2012). It relies on the International Comparison Program (ICP) carried by the World Bank that aims at providing comparable international prices. Based on this framework, Eurostat and OECD have computed Comparative Price Level (CPL) series for each European country. These CPLs are defined by the OECD as the ratio between purchasing power parity conversion factor for private consumption[4] and the nominal exchange rate. This ratio measures price level differences between two countries (in our case between a European country and the United States) and can be expressed as follows:

$$CPL_{i,t} = \frac{PPP_{i,t}}{NER_{i,t}} \times 100 \tag{4.12}$$

where $PPP_{i,t}$ stands for the PPP conversion factor for private final consumption of country $i$ relative to the United States at time $t$, expressed in euros per US dollar, and $NER_{i,t}$ is the euro/dollar exchange rate at time $t$. Turning to data availability, CPLs are computed by Eurostat and OECD for each European country annually only since 1995. It is however possible to recover monthly observations using the price evolution relative to the US in each European country—i.e. using the relative CPIs corrected by the exchange rate variations. More specifically, we construct the monthly domestic price level series of country $i$ on the period from January 1999 to July 2011 as follows:[5]

$$P_{i,t} = \frac{PPP_{i,2005}}{NER_{i,2005}} \times \frac{\frac{CPI_{i,t}}{CPI_{i,2005}}}{\frac{NER_{i,t}}{NER_{i,2005}} \times \frac{CPI_{US,t}}{CPI_{US,2005}}} \times 100 \tag{4.13}$$

where $i = 1, ..., 12$ denotes the European country. $PPP_{i,2005}$ is the PPP for private con-

[4]Following the World Bank definition, the PPP conversion factor for private consumption is the number of units of a country's currency required to buy the same amount of goods and services in the domestic market as a US dollar would buy in the United States, the conversion factor being applicable to private consumption.

[5]See Guerreiro and Mignon (2011), and Guerreiro et al. (2012).

sumption for country $i$ relative to the US in 2005 (euros per US dollar). $CPI_{i,t}$, $CPI_{i,2005}$, $CPI_{US,t}$ and $CPI_{US,2005}$ are respectively the country $i$'s CPI at time $t$ and at year 2005, and the US CPI at time $t$ and at year 2005. $NER_{i,2005}$ is the euro/dollar exchange rate in year 2005. 2005 has been chosen as the basis year because it corresponds to the year of the last ICP survey realized by the World Bank.[6] From Equation (4.13), we thus obtain 12 series of price levels that can be used to test absolute PPP.

So as to test the UIP side of the CHEER, we employ the bond rate at ten years coming from Datastream. Given the importance of Germany in the Eurozone, we retain this country as the benchmark. Thereby, we investigate UIP and PPP between each member of the EMU and Germany.

## 4.4 Results

### 4.4.1 Specifying the VARs and testing causality

Completing the study of CHEER between each Eurozone member and Germany involves the specification and the estimation of eleven bivariate VARs. The first concern when considering the VAR specification is to evaluate the integration order of each variable entering the system. To this end, we execute, for each of the twelve countries belonging to Euroland, the tests proposed by Ng and Perron (2001) and by Lee and Strazicich (2003) on the long interest rates ($i_t^l$) and on price levels ($p_t$) series. Compared with usual unit-root tests as Dickey-Fuller (1979) or Phillips-Perron (1988), Ng and Perron (2001) supply a better size and power by selecting more precisely the lag length thanks to a modified AIC (MAIC) sample dependent penalty, while Lee and Strazicich (2003) account for possible breaks in the series. Regardless the tests, results point to the same direction: for all the countries, the two series are integrated at the first order.[7]

Before testing the cointegration rank in CVARs, we have to secure that the model presents the desired statistical properties to get reliable cointegrating estimates. That is why we notify in Table 4.2 the results of misspecification tests on the eleven unrestricted VARs.

[6] $PPP$ series are extracted from the OECD database. NER and CPI series are from IFS, except the German and the Irish CPIs that come from Datastream.

[7] To save space, results are not reported but are available upon request to the author.

Table 4.2: **Misspecification tests of the 11 unrestricted VARs**

| Domestic country | $LM_{(1)}$ | $LM_{(4)}$ | Skewness | Kurtosis | Dummy variables | Lag |
|---|---|---|---|---|---|---|
| Austria | $\chi^2(16) = 21.61$ $p = 0.156$ | $\chi^2(16) = 20.69$ $p = 0.19$ | $\chi^2(4) = 6.11$ $p = 0.19$ | $\chi^2(4) = 34.13$ $p = 0$ | 99:11 03:05 07:06 | 4 |
| Belgium | $\chi^2(16) = 20.19$ $p = 0.21$ | $\chi^2(16) = 19.59$ $p = 0.24$ | $\chi^2(4) = 3.61$ $p = 0.46$ | $\chi^2(4) = 59.37$ $p = 0$ | none | 5 |
| Finland | $\chi^2(16) = 25.9$ $p = 0.05$ | $\chi^2(16) = 17.2$ $p = 0.37$ | $\chi^2(4) = 7.75$ $p = 0.10$ | $\chi^2(4) = 28.67$ $p = 0$ | 03:05 08:12 | 3 |
| France | $\chi^2(16) = 12.53$ $p = 0.71$ | $\chi^2(16) = 12$ $p = 0.74$ | $\chi^2(4) = 3.6$ $p = 0.46$ | $\chi^2(4) = 73.74$ $p = 0$ | 08:03 08:10 | 4 |
| Greece | $\chi^2(16) = 19.5$ $p = 0.46$ | $\chi^2(16) = 22.32$ $p = 0.13$ | $\chi^2(4) = 0.98$ $p = 0.91$ | $\chi^2(4) = 69.23$ $p = 0$ | none | 7 |
| Ireland | $\chi^2(16) = 36.83$ $p = 0.01$ | $\chi^2(16) = 10.02$ $p = 0.86$ | $\chi^2(4) = 0.99$ $p = 0.91$ | $\chi^2(4) = 33.41$ $p = 0$ | none | 7 |
| Italy | $\chi^2(16) = 17.62$ $p = 0.34$ | $\chi^2(16) = 21.21$ $p = 0.17$ | $\chi^2(4) = 4.34$ $p = 0.36$ | $\chi^2(4) = 35.9$ $p = 0$ | 99:04 11:07 | 2 |
| Luxembourg | $\chi^2(16) = 19.08$ $p = 0.26$ | $\chi^2(16) = 18.86$ $p = 0.27$ | $\chi^2(4) = 1.41$ $p = 0.84$ | $\chi^2(4) = 26.71$ $p = 0$ | none | 7 |
| Netherlands | $\chi^2(16) = 10.55$ $p = 0.83$ | $\chi^2(16) = 19.94$ $p = 0.22$ | $\chi^2(4) = 2$ $p = 0.73$ | $\chi^2(4) = 14.75$ $p = 0.01$ | none | 7 |
| Portugal | $\chi^2(16) = 23.10$ $p = 0.11$ | $\chi^2(16) = 15.7$ $p = 0.47$ | $\chi^2(4) = 2.2$ $p = 0.7$ | $\chi^2(4) = 19.92$ $p = 0$ | none | 7 |
| Spain | $\chi^2(16) = 31.78$ $p = 0.01$ | $\chi^2(16) = 9.85$ $p = 0.87$ | $\chi^2(4) = 6.07$ $p = 0.19$ | $\chi^2(4) = 21.87$ $p = 0$ | 99:11 03:05 08:06 10:05 | 7 |

Note: Foreign country in each unrestricted VAR is Germany. $LM_{(1)}$ and $LM_{(4)}$ are respectively the statistics of the first and the fourth order LM autocorrelation tests. $p$ stands for p-value.

Relating to autocorrelation, we notice that properties are broadly respected even if the VARs of Ireland on one hand, and Spain on the other, display first order autocorrelation of residuals. About normality, we deliver skewness and kurtosis separately, because as evidenced by Gonzalo (1994) cointegration results are relatively robust to excess of kurtosis but not to skewness deviation. The likelihood ratio tests decide in favor of centered residuals in all the cases, authorizing us to go forward by performing the cointegration tests.

Table 4.3: **Johansen cointegration tests**

| | Austria | | Belgium | | Finland | | France | |
|---|---|---|---|---|---|---|---|---|
| | $\lambda_{max}$ | Trace | $\lambda_{max}$ | Trace | $\lambda_{max}$ | Trace | $\lambda_{max}$ | Trace |
| $r \leq 3$ | 0.17 | 0.17 | 0.01 | 0.01 | 1.04 | 1.04 | 0.02 | 0.02 |
| $r \leq 2$ | 9.25 | 9.42 | 3.45 | 3.47 | 5.39 | 6.44 | 2.19 | 2.22 |
| $r \leq 1$ | 10.62 | 20.05 | 8.39 | 11.86 | 9.94 | 16.39 | 12.17 | 14.39 |
| $r = 0$ | 35.62*** | 55.68*** | 29.64** | 41.51 | 19.13 | 35.52 | 35.55*** | 49.94** |
| | Greece | | Ireland | | Italy | | Luxembourg | |
| | $\lambda_{max}$ | Trace | $\lambda_{max}$ | Trace | $\lambda_{max}$ | Trace | $\lambda_{max}$ | Trace |
| $r \leq 3$ | 1.34 | 1.35 | 1.45 | 1.45 | 0.12 | 0.12 | 0.03 | 0.03 |
| $r \leq 2$ | 7.24 | 8.59 | 8.99 | 10.44 | 6.22 | 6.34 | 3.94 | 3.97 |
| $r \leq 1$ | 16.42 | 25.02 | 18.89 | 30 | 9.29 | 15.63 | 9.27 | 13.24 |
| $r = 0$ | 33.81*** | 58.83*** | 46.55*** | 75.88*** | 30.51** | 46.14* | 33.67*** | 46.91* |

| | Netherlands | | Portugal | | Spain | |
|---|---|---|---|---|---|---|
| | $\lambda_{max}$ | Trace | $\lambda_{max}$ | Trace | $\lambda_{max}$ | Trace |
| $r \leq 3$ | 7.46 | 7.46 | 5.47 | 5.47 | 0.25 | 0.25 |
| $r \leq 2$ | 12.47 | 20.11 | 15.42 | 20.89 | 14.26 | 9 |
| $r \leq 1$ | 21.62 | 41.73 | 21.03 | 41.93 | 21.13 | 21.72 |
| $r = 0$ | 33.74** | 75.48** | 41.42**** | 83.55*** | 27.58*** | 54.46** |

Note: * (resp. **, ***) denotes rejection of the null hypothesis of no cointegration with Germany at the 10% (resp. 5%, 1%) level.

### 4.4.2 Testing rank integration and causality

Table 4.3 reports the results of max-eigenvalue and trace cointegration tests proposed by Johansen. The estimation of associated cointegrating vectors is reported in Table 4.7 in the Appendix.

The outcomes illustrate that a sole cointegrating relationship between interest rates and price levels differentials relative to Germany exists for each European country except Finland. It implies that parities deviations relative to Germany are effectively connected for all the Eurozone members, Finland apart. This connexion partly supports the view we developed whereby external disequilibriums may be at roots of the sovereign crisis. Nevertheless, to fully confirm this statement, we have to make sure about the direction of causal links by testing if causality runs from the prices to the interest rates. This may be achieved throughout weak exogeneity tests. If in general, weak exogeneity is used to determine which are the driving variables of the system by identifying the possible feed-

Table 4.4: **Weak exogeneity**

| | Austria | | Belgium | | France | | Greece | | Ireland | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val |
| $i^l$ | 12.15 | 0 | 10.12 | 0.001 | 18.86 | 0 | 17.1 | 0 | 4.82 | 0.03 |
| $i^{l^*}$ | 19.53 | 0 | 15.85 | 0 | 16.18 | 0 | 0.75 | 0.385 | 10.33 | 0.001 |
| $p$ | 0.01 | 0.92 | 0.6 | 0.43 | 2.76 | 0.1 | 0.09 | 0.758 | 0.094 | 0.76 |
| $p^*$ | 0.001 | 0.97 | 0.92 | 0.335 | 3.64 | 0.056 | 0.33 | 0.564 | 0.172 | 0.67 |
| $i^l$ and $i^{l^*}$ | 21.57 | 0 | 16.89 | 0 | 20.21 | 0 | 18.47 | 0 | 28.86 | 0 |
| $p$ and $p^*$ | 1.66 | 0.43 | 5.48 | 0.07 | 10.56 | 0.005 | 2.26 | 0.322 | 0.765 | 0.68 |
| | Italy | | Luxembourg | | Netherlands | | Portugal | | Spain | |
| | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val |
| $i^l$ | 14.94 | 0 | 0.419 | 0.51 | 10.28 | 0.001 | 9.78 | 0.001 | 6.96 | 0.008 |
| $i^{l^*}$ | 15.37 | 0 | 13.64 | 0 | 10.97 | 0 | 0.713 | 0.398 | 17.7 | 0 |
| $p$ | 4.59 | 0.032 | 0.64 | 0.423 | 3.54 | 0.06 | 0.104 | 0.746 | 0.001 | 0.97 |
| $p^*$ | 4.79 | 0.028 | 1.05 | 0.3 | 4.51 | 0.033 | 0.263 | 0.607 | 0.093 | 0.76 |
| $i^l$ and $i^{l^*}$ | 15.89 | 0 | 22.87 | 0 | 11.17 | 0.003 | 20.02 | 0 | 19.18 | 0 |
| $p$ and $p^*$ | 5.07 | 0.08 | 5.26 | 0.07 | 11.19 | 0.003 | 2.27 | 0.249 | 8.85 | 0.012 |

Note: $\nu = 1$ for individual and $\nu = 2$ for joint test.

backs of the long-run levels (McDonald and Juselius, 2003), Hall and Milne (1994) argue that it can also be employed to test a form of long-run causality they call weak causality (Table 4.3). According so, weak exogenous prices suggest that causality runs from goods to capital market (*i.e.* PPP disequilibriums entail UIP disequilibriums).

As shown in Table 4.4 for the majority of countries (Austria, Belgium, Greece, Ireland, Italy, Luxembourg and Portugal), the assumption of weak exogeneity is rejected for joint interest rates and not rejected for joint prices, denoting that the increase of interest differentials can be assigned to non stationary price differentials. These findings corroborate that sovereign debt crisis is due to a balance of payments crisis for these countries. For France and Spain the causality direction is not challenged, but it is more restricted since prices are weakly exogenous only when they are tested individually. Finally, the Netherlands exhibit a two-way causal relationship given that only the domestic price is weakly exogenous, which goes against the balance of payments crisis theory.

Table 4.5: **Restrictions tests**

| Hypothesis | Austria | | Belgium | | France | | Greece | | Ireland | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val |
| $A$ | 31.24 | 0 | 21.73 | 0 | 31.03 | 0 | 12.75 | 0 | 33.24 | 0 |
| $B$ | 23.94 | 0 | 20.07 | 0 | 31.02 | 0 | 1.22 | 0.54 | 1.8 | 0.40 |
| $C$ | 0.47 | 0.49 | 0.458 | 0.5 | 6.66 | 0.01 | 2.53 | 0.11 | 0.139 | 0.71 |
| | Italy | | Luxembourg | | Netherlands | | Portugal | | Spain | |
| | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val | $\chi^2(\nu)$ | p-val |
| $A$ | 21.99 | 0 | 30.89 | 0 | 11.7 | 0 | 24.43 | 0 | 27.2 | 0 |
| $B$ | 20.22 | 0 | 24.2 | 0 | 11.40 | 0 | 2.54 | 0.28 | 24.48 | 0 |
| $C$ | 5.57 | 0.02 | 0.03 | 0.86 | 0.058 | 0.81 | 2.16 | 0.14 | 0.93 | 0.33 |

Note: In hypothesis B, $|\gamma|$ is equal to 5.82 in Greece, 12.72 in Ireland, and 5.9 in Portugal.
$\nu = 3$ for hypothesis A, $\nu = 2$ for hypothesis B, $\nu = 1$ for hypothesis C.

### 4.4.3 Long-run relationships

As evidenced in section 4.3.2, long-term structure of the CVAR can be compared to the theoretical predictions by imposing restrictions on the cointegrating vector $\beta$. Resting on Table 4.1, we investigate the sensitivity of interest differentials to price differentials in each country relative to Germany.

Results in Table 4.5 show that for each country, the strongest version of CHEER is discarded with a p-value of 0. Even if PPP deviations entail UIP departures (according to weak exogeneity tests), the elasticity between these two components is lower than 1. The semi-strong sensitivity (elasticity ranging from ]0;1[) is accepted for Greece, Ireland and Portugal, but rejected for the rest of the panel. Finally, weak sensitivity is accepted for our entire panel except France and Italy that display very small p-values (0.01 and 0.02). Overall, these results attest that the countries that appealed to international assistance are the most sensitive to external imbalances in the Eurozone: in order to stay in the monetary union (*i.e.* keep their nominal exchange rate equal to zero relative to Germany), they have to face a greater increase of their domestic rates than the rest of the European countries. On the opposite, France and Italy are the countries that disclose the weakest sensitivity since any constrained model is accepted. Between these two groups lie Austria, Belgium, Luxembourg and Spain, where restrictions on PPP are respected, but UIP is unrestricted.

Drawing a parallel with the sovereign debt crisis, these findings (supplemented by those of

causality tests reported in section 4.4.2) are very informative on the causes and the form of the crisis. Indeed, they support the idea that Greece, Ireland and Portugal have experienced a balance of payment crisis as described in section 4.2.2. The irrevocably fixed parity relative to Germany prevents these countries from solving their external disequilibrium by devaluating their currency. In the absence of real adjustments, deficits have been financed thanks to borrowing, pressuring upward interest rates until the financing costs were unsustainable, which forced these countries to ask for international relief. Regarding the rest of the Euroland, there is no manifest proof of such eventuality. Two-way causality challenges the view that PPP deviations are at the roots of interest rates differentials increase for the Netherlands. Any meaningful economic restrictions have been found relevant for France and Italy, and only weak restrictions are accepted for the remaining countries, suggesting that price differentials explain only a small part of interest differentials dynamics. Results are somewhat surprising for Spain and Italy, since only a small part of the increase in their interest differentials relative to Germany is due to external disequilibriums, whilst they are considered as "weak links" of the EMU. A likely reason for these differentials may lie in the threat of a contagion effect. This is supported by the weak exogeneity tests: unlike the other countries individual and joint prices are not both weakly exogenous for these two economies, which may indicate a certain disconnection between prices and interest rates.

### 4.4.4 Short-run adjustments

When restrictions on cointegrating vectors $\beta$ are significant as it is the case for our entire panel except France and Italy, we can detect the short-run drivers as well as their adjustment speed towards the equilibrium state by imposing additional restrictions on $\alpha$. These are simple tests of weak exogeneity implemented on restricted, rather than on unrestricted vectors, that aim at finding out which variables are unresponsive to restore equilibrium. Table 4.6 provides the loading parameters of the restricted $\beta$, and the unresponsive variables.

As expected, (domestic and foreign) prices are unresponsive in all countries but the Netherlands, substantiating that adjustment towards joint stationarity of PPP and UIP is made through interest rates. However, there are some disparities between countries regarding drivers and their importance. While for Greece and Portugal, only domestic interest rates are at play, for Austria, Belgium, Ireland, and Spain, both domestic and German interest

Table 4.6: **Short-run adjustments**

| Domestic country | | | $\Delta i^l$ | $\Delta i^{l^*}$ | $\Delta p$ | $\Delta p^*$ |
|---|---|---|---|---|---|---|
| Austria | loading parameters | *coeff* | 0.09 | 0.121 | -0.031 | -0.08 |
| | | *s.e.* | (0.021) | (0.022) | (0.41) | (0.401) |
| | unresponsiveness | $\chi^2(2)$ | 15.73 | 23.57 | 0.47 | 0.51 |
| | | *p-value* | 0 | 0 | 0.79 | 0.77 |
| Belgium | loading parameters | *coeff* | 0.044 | 0.06 | -0.12 | -0.16 |
| | | *s.e.* | (0.013) | (0.013) | (0.131) | (0.232) |
| | unresponsiveness | $\chi^2(2)$ | 10.95 | 18.97 | 0.76 | 1.01 |
| | | *p-value* | 0 | 0 | 0.68 | 0.6 |
| Greece | loading parameters | *coeff* | -0.017 | -0.002 | -0.002 | -0.009 |
| | | *s.e.* | (0.003) | (0.001) | (0.025) | (0.024) |
| | unresponsiveness | $\chi^2(3)$ | 25.46 | 3.2 | 1.23 | 1.38 |
| | | *p-value* | 0 | 0.36 | 0.74 | 0.71 |
| Ireland | loading parameters | *coeff* | -0.005 | 0.004 | -0.012 | -0.014 |
| | | *s.e.* | (0.002) | (0.001) | (0.026) | (0.026) |
| | unresponsiveness | $\chi^2(3)$ | 9.037 | 10.81 | 2.07 | 2.16 |
| | | *p-value* | 0.03 | 0.01 | 0.55 | 0.53 |
| Luxembourg | loading parameters | *coeff* | 0.008 | 0.043 | -0.15 | -0.202 |
| | | *s.e.* | (0.013) | (0.012) | (0.21) | (0.207) |
| | unresponsiveness | $\chi^2(2)$ | 0.43 | 13.77 | 0.69 | 1.17 |
| | | *p-value* | 0.8 | 0.001 | 0.708 | 0.55 |
| Netherlands | loading parameters | *coeff* | 0.042 | 0.043 | -0.46 | -0.53 |
| | | *s.e.* | (0.011) | (0.011) | (0.193) | (0.194) |
| | unresponsiveness | $\chi^2(2)$ | 10.31 | 12.44 | 5.91 | 7.58 |
| | | *p-value* | 0.05 | 0.002 | 0.052 | 0.022 |
| Portugal | loading parameters | *coeff* | -0.024 | 0.003 | -0.118 | -0.129 |
| | | *s.e.* | (0.007) | (0.005) | (0.083) | (0.082) |
| | unresponsiveness | $\chi^2(3)$ | 14.77 | 2.97 | 4.58 | 4.95 |
| | | *p-value* | 0.002 | 0.396 | 0.205 | 0.176 |
| Spain | loading parameters | *coeff* | 0.015 | 0.021 | -0.025 | -0.059 |
| | | *s.e.* | (0.007) | (0.005) | (0.083) | (0.082) |
| | unresponsiveness | $\chi^2(2)$ | 7.59 | 17.8 | 0.36 | 0.81 |
| | | *p-value* | 0.022 | 0 | 0.836 | 0.668 |

Note: For Greece, Ireland and Portugal we retain the restricted vector coming from hypothesis B, while for Austria, Belgium, Luxembourg, the Netherlands an Spain, we keep that of hypothesis C.

rates participate to adjustments. For Austria, Belgium and Spain, the main driver is the German rate, whereas for Ireland, domestic and German rates are equivalent. Finally, only the German interests restore the equilibrium for Luxembourg.

## 4.5 Conclusion

In this chapter, we investigate whether the sovereign debt crisis experienced by some EMU countries is actually a balance of payments crisis generated by the occurrence of large external disequilibriums relative to main partners. If the latter have largely been pointed out to explain the sources of the debt crisis, there is no study establishing formal relationships between external imbalances and the sharp increase of interest rates inside Eurozone. To overcome this shortcoming we rely on the equilibrium exchange rate model initiated by Juselius (1991, 1995), the CHEER approach.

Theoretically, we show that in a currency union, external imbalances of a country *vis-à-vis* a partner (that is a violation of PPP between these two countries) may traduce into a balance of payments crisis if real adjustments are too difficult to implement. Indeed, we evidence that external disequilibriums entail a raise in interest differential in order to keep fixed parities between members. In a monetary union, since real imbalances cannot be mitigated by monetary instruments (as the nominal exchange rate), only real adjustments that reduce these imbalances are available. Then, persistence of large external disequilibriums (that traduces an inability to implement structural adjustments) challenges on the long run the monetary commitments: the deficits aggravate the net foreign asset position raising the amount needed for servicing the debt, that in turns fuels the external imbalances. This snowball effect is likely to force the deficit country to exit the monetary union in order to recover competitiveness by devaluating its currency.

Empirically, we carry out a cointegration analysis between each EMU country and Germany to ascertain our theoretical predictions. We find that a cointegrating long-run relationship exists between goods market and capital market (relative to Germany) for each country except Finland. Moreover, causality tests indicate that, among the sample of countries for which cointegration is found, causality is unidirectional and runs from PPP to UIP, except in the Netherlands, where it is bidirectional. Finally, we show that the countries

under assistance (Greece, Ireland and Portugal) exhibit the greatest sensitivity to external disequilibrium, whilst France and Italy seem relatively immune.

Generally speaking, our results attest that Greece, Ireland and Portugal are experiencing a balance of payments crisis. The sky-high interest rates they faced forced them to ask for Troïka assistance in order to not withdraw from Euro and have some extra time to implement structural adjustment policies. Notwithstanding, the former hypothesis cannot be discarded, since, as illustrated by Greece, structural adjustment is obviously socially costly and poorly accepted by people. For Spain and Italy disequilibriums seem to play a limited role, a result than can be explained by the fact that part of their interest differential increase relative to Germany is due to the so-called contagion effect. Finally, even if Austria, Belgium, France, Luxembourg and the Netherlands have undergone some (moderated) pressures on their interest rates, there is no evidence of a beginning balance of payments crisis. On the whole, our findings put forward important differences between peripheral and core countries regarding the interpretation of the current debt crisis.

Until now, we have based our analyzes on the framework of optimality and paid attention only to EMU. However, as it has been raised by Goodhart (1995, 1998), the approach in terms of optimality may be to normative and hence somewhat biased to apprehend an event he considers as mainly political. CFA zone seems to be a fair example of this political rather than economic union, since the commitments date back from the colonial period.

In order to assess the long-living of this currency area, we introduce in the upcoming chapter the idea of currency union sustainability, and try to test it relying on the BEER methodology.

## 4.6 Appendix

Table 4.7: **Cointegrating space**

| | Austria | Belgium | France | Greece | Ireland |
|---|---|---|---|---|---|
| | *Standardized Eigenvectors* $\beta$ | | | | |
| $i^l$ | 1 | 1 | 1 | 1 | 1 |
| $i^{l^*}$ | -3.76 | -2.95 | -0.74 | -0.07 | -0.65 |
| $p$ | -1.91 | -1.03 | 0.29 | 0.41 | 0.09 |
| $p^*$ | 1.92 | 1.05 | -0.3 | -0.45 | -0.08 |
| $trend$ | - | - | - | - | - |
| | *Adjustment coefficients* $\alpha$ | | | | |
| $\Delta i^l$ | 0.0527 | 0.0456 | -0.5447 | 0.0889 | 0.0595 |
| $\Delta i^{l^*}$ | 0.0679 | 0.0614 | -0.5245 | 0.0068 | -0.0635 |
| $\Delta p$ | -0.0771 | -0.1893 | 3.6286 | 0.0481 | 0.118 |
| $\Delta p^*$ | -0.1106 | -0.2389 | 4.205 | 0.0851 | 0.1633 |
| | Italy | Luxembourg | Netherlands | Portugal | Spain |
| | *Standardized Eigenvectors* $\beta$ | | | | |
| $i^l$ | 1 | 1 | 1 | 1 | 1 |
| $i^{l^*}$ | 11.64 | -3.53 | 1.21 | -0.82 | 0.5 |
| $p$ | 6.81 | -0.88 | 0.91 | 0.13 | 0.26 |
| $p^*$ | -7.24 | 0.89 | -0.92 | -0.11 | 0.25 |
| $trend$ | - | - | 0.0002 | -0.0001 | - |
| | *Adjustment coefficients* $\alpha$ | | | | |
| $\Delta i^l$ | -0.0069 | 0.0096 | -0.046 | 0.1508 | -0.0524 |
| $\Delta i^{l^*}$ | -0.0077 | 0.049 | -0.0473 | -0.0284 | -0.0729 |
| $\Delta p$ | 0.0677 | -0.1964 | 0.553 | 0.02091 | 0.018 |
| $\Delta p^*$ | 0.0689 | -0.2514 | 0.629 | 0.3254 | 0.1047 |

# Chapter 5

# Revisiting the theory of optimum currency areas: Is the CFA franc zone sustainable?[1]

[1] Note: A first verion of this chapter has been published as Couharde, C., Coulibaly, I., Guerreiro, D., and V. Mignon (2012), "Revisiting the theory of optimum currency areas : Is the CFA franc zone sustainable?", Working Paper CEPII n°2012-13.

## 5.1 Introduction

Created in 1945 during the Bretton-Woods agreements, the CFA franc (*Franc des Colonies Françaises d'Afrique*) initially aimed to help France to recover its "special links" with its colonies undermined by World War II. Political independencies in the 1960s have resulted in a reorganization of the monetary agreement, leading to the introduction of two monetary unions with their own currency referred to the CFA franc. The two currencies, initially pegged to the French franc, have been both pegged to the euro at the same parity of 655.96 CFA per euro since the launch of the European currency. However, they are not directly convertible between each other. The first CFA franc (*Franc de la Communauté Financière de l'Afrique*), issued by the Central Bank of West African States,[2] is the legal tender of the West African Monetary Union (WAEMU),[3] while the second one (*Franc de la Coopération Financière Africaine*), issued by the Bank of Central African States, is the legal tender of the Central African Monetary Area (CAEMC).[4] The convertibility of the CFA francs is however unlimited relative to euro and totally granted by the French Treasury. While capital flows are free inside the franc zone,[5] exchange-rate reserves must be centralized in the two central banks, and at least 65% must be deposited in a special operating account held by the French Treasury. Moreover, France has a decisional power in the CFA zone since it is represented by a delegate in the executive boards of the two central banks.[6]

The monetary agreement has endured over time; despite significant events that could call it into question such as political independencies in the 1960s, the strong devaluation of the CFA franc in 1994 or the launch of the single currency in Europe. It has thus often been a point of reference for other countries in the area, even though it is not the only experience regarding regional monetary integration.[7]

However, the CFA zone has also been challenged and whether it has been beneficial or

[2] *Banque Centrale des Etats d'Afrique de l'Ouest.*

[3] The West African Economic and Monetary Union is composed by Benin, Burkina Faso, Guinea Bissau, Ivory Coast, Mali, Niger, Senegal, and Togo.

[4] The Central African Economic and Monetary Community is composed by Cameroon, Central African Republic, Chad, Congo Brazzaville, Equatorial Guinea, and Gabon.

[5] In fact since the two CFAs are not directly convertible, free capital movements exist only between France and each issuance area.

[6] To go further on the agreements administering the operation of the franc zone, which rule the CFA franc, see Hajimichael and Galy (1997), or Banque de France (2002).

[7] The other monetary union is the Common Monetary Area (CMA) created in the 1920s. It is composed by the Republic of South Africa with two former British colonies, Lesotho and Swaziland, and Namibia.

detrimental over the past has been much discussed and analyzed.[8] Usual concerns refer to the economic rationale for this monetary union, i.e. the relevance for these countries to share the same currency, regarding the challenges of growth and development in the area. This issue has been mainly studied by referring to the Optimum Currency Area (OCA) criteria. However, empirical studies have been unable to draw clear-cut conclusions on the optimality of the CFA zone. This can be obviously linked to the limitations of the OCA framework in explaining the actual formation of monetary unions. Thus, some economists such as Goodhart (1995) have challenged the relevance of economic criteria on the grounds that currency area formation is mainly dominated by political considerations. However, even though the OCA analysis can be challenged on political grounds, it has also been frequently criticized for providing several heterogeneous properties which are not necessarily linked and are unlikely to be met. Moreover, Tavlas (1994) mentions a lack of consensus on the weight given to each of those criteria which has resulted in a "problem of inconclusiveness". Indeed, conclusions appear very sensitive to the criteria that are being applied (see Willett, 2001, for a critical review of the OCA theory).

In order to overcome the drawbacks of the OCA framework, we propose an alternative approach that highlights the sustainability of the CFA zone rather than its optimality. Thus, our aim is not to provide an additional criterion, neither a replacement for OCA criteria, but rather to develop an approach that focuses on economic conditions that have ensured the durability of the exchange-rate commitment over time. Indeed, despite the CFA zone countries failed to meet several major criteria for being an OCA, the currency union has survived, suggesting that the CFA zone, while not being optimal, has been at least sustainable. More specifically, we define a sustainable currency area as a monetary union in which real exchange rates do not deviate persistently from their equilibrium paths. Indeed, such currency union can be considered as fostering internal and external balances and/or facilitating the adjustment to shocks and then be qualified as sustainable. As illustrated by the recent experience of the EMU, where real exchange rates differences have strongly increased (Coudert et al., 2012), the challenge faced by any monetary union is to prevent unacceptable economic disequilibrium from persisting in any part of the monetary area.

We test this sustainability hypothesis by analyzing real exchange rates dynamics on the grounds that, as real exchange rates affect and are affected by all other policies, their

[8] See references in Section 5.2.

behavior can then give a good indication of the functioning of an exchange-rate regime. We rely on the Behavioral Equilibrium Exchange Rate (BEER) approach to estimate the convergence process of real exchange rates towards equilibrium. In particular, we check whether this convergence process has been more effective in the CFA franc zone, compared to a control group. The latter includes a sample of other sub-Saharan African (SSA) countries which share most of the salient features of the CFA zone countries (commodities producers, low or middle-income countries), except the exchange-rate regime.

Relying on annual data over the 1985-2009 period, three main findings emerge from our analysis. We first evidence that real exchange rates converge toward their equilibrium level faster in the CFA zone than in other SSA countries. Secondly, our results show the key role of fundamentals in this convergence process in the CFA zone, while in the other SSA countries, the adjustment mainly stems from the exchange-rate policy. Finally, this result still holds when individual members of the CFA zone are considered, suggesting that the CFA agreements have been sustainable not only for the whole CFA area but also for each of its member countries.

The rest of the chapter is organized as follows. Section 5.2 points the limits of the OCA criteria for the CFA franc zone and presents our approach in terms of sustainability. Section 5.3 describes the econometric methodology and displays our empirical results for the whole CFA zone. Section 5.4 gives additional details on the sustainability issue by providing a country-by-country analysis. Section 5.5 concludes.

## 5.2 The CFA zone: from non optimality to sustainability

The CFA zone looks back to a history of more than 60 years of monetary integration. Its birth resulted from a political decision between France and its former SSA colonies, and was therefore exogenous to economic considerations. In particular, it was created while the economic requirements needed for forming a monetary area were not satisfied (Dufrénot and Sugimoto, 2009). However, although these requirements were not meet *ex ante*, whether they could be verified *ex post* has been widely debated in the literature. This issue has been mainly studied by applying the OCA criteria to the CFA franc zone.

### 5.2.1 The CFA zone and the optimality criteria

Within this literature, some authors have focused on the regional or idiosyncratic nature of shocks facing the member countries. Estimating a VAR model, Fielding and Shields (2001) show that the CFA countries have been characterized by symmetric price shocks while output shocks seem to be asymmetric. Zhao and Kim (2009) use a similar methodology while examining a richer set of shocks. They find that domestic outputs of the CFA franc zone countries are strongly influenced by country-specific shocks while regional shocks are far less important than in EMU countries. The authors conclude that the CFA franc zone countries are structurally different from each other and are thus more likely to be subject to asymmetric shocks. Bénassy-Quéré and Coupet (2005) carry out a cluster analysis which allows them to assess the similarity (symmetry) between countries. Their findings show that CAEMC and WAEMU countries do not belong to the same clusters, indicating structural differences inside the CFA zone. Following the framework developed by Bayoumi and Eichengreen (1997) for European countries, Bangaké (2008) derives an OCA index for the CFA zone countries by regressing the bilateral nominal exchange-rate volatility on variables used in the standard literature of OCA (asymmetric disturbances to output, dissimilarity of the commodity composition of exports, trade linkages and size). His results reveal structural convergence between the WAEMU countries, indicating an optimal currency area, while the CAEMC economies tend to diverge.

Studies which investigate trade-generating effects of the currency union reach more optimistic results. Indeed, the common currency seems to have promoted closer trade links and more synchronized cycles (Masson and Pattillo, 2004; Tsangarides et al., 2009). However, differentiating the effects of hard pegs (currency unions) from conventional soft pegs, Qureshi and Tsangarides (2012) find more nuanced results: the trade-generating effect of pegs is at least as large for Africa as that of currency unions, suggesting that trade-generating effects are not a specific feature of currency unions in African countries. Still, even though progress has been made in this area, the lack of product diversification still results in a very low ratio of intra-zone trade. According to Yehoue (2006), it stood at about 9.6 percent over the 1960-2004 period for the CFA zone, compared to an average of 60 percent for the European Union. Finally, another factor often posited to help the workings of a currency area is risk-sharing, which in turn would be encouraged by the

establishment of a currency union. However, this does not appear to have been a major factor within the CFA countries which are still characterized by a low integration of credit and capital markets (Yehoue, 2006).

These mitigated conclusions are in sharp contrast with the optimistic vision according to which the CFA zone has enhanced credibility and disciplined national monetary and fiscal policies of its member countries.[9] Indeed, as those countries lack a well-developed financial infrastructure including sophisticated financial institutions and broad and deep markets for foreign exchange, pegs can provide a simple and credible anchor for monetary policy. Likewise, countries lacking internal discipline for monetary policy (as revealed by a history of high and variable inflation) stand to gain more from giving up their currencies, provided that the anchor country is able to commit to sound monetary policy (Alesina and Barro, 2002). The analysis of monetary and fiscal performances in those countries tends to corroborate this view, by evidencing lower inflation rates and more fiscal discipline than for the non-CFA countries. Devarajan and de Melo (1990) find that the average inflation rate of the CFA countries continued to be lower than other African economies in the 1980s while their performance was noticeably worse in terms of GDP, export growth and investment levels. This result has been supported more recently by Yehoue (2006), who evidences that the CFA member countries have outperformed the non-CFA countries in terms of inflation over the 1960-2004 period and brought down their fiscal deficit after the 1994-devaluation. The CFA zone countries have also benefited from a more stable economic and financial environment (Masson and Patillo, 2004), that has conventionally been associated to their irrevocable commitment to a fixed exchange-rate regime and guaranteed convertibility of their currency.

These results demonstrate the difficulties in obtaining clear-cut conclusions when the OCA analysis is mobilized in order to determine the optimum area for a single currency. As emphasized by Devarajan and Rodrik (1991), this problem of inconclusiveness illustrates rather the tradeoffs between inflation benefits and output costs involved by the currency union membership. Indeed, while in the long run one cannot trade off higher inflation

[9]Strictly speaking, credibility does not explicitly belong to the OCA theory. However, the establishment of EMU led to some revisions of the analytical framework of the theory with a reconsideration of the effective costs and benefits from monetary integration. The credibility issue is clearly part of this reassessment, as illustrated by DeGrauwe (1996, 2000, 2011) among others arguing that credibility plays the key role in explaining the success or the collapse of such unions. In particular, according to this author, credibility has played the key role in explaining the European Monetary System crisis in 1992-1993.

for more rapid growth and lower unemployment, tradeoffs still exist in the short run and thus there is still a plausible (if controversial) case for using the nominal exchange rate as an adjustment mechanism to help soften the effects of shocks. Developing a formal framework for clarifying those tradeoffs, Devarajan and Rodrik (1991) find that, for most CFA members, the inflation benefits do not appear to have been large enough to offset the costs on the output side. However, they recognize that their results should be interpreted with cautious as they have ignored some important features of the currency union—savings obtained by pooling reserves, attractiveness to foreign investors of a convertible currency, and the special relationship with France—and made also strong hypotheses (CFA policy makers would have followed the appropriate exchange-rate policies in response to terms of trade shocks).

In summary, there is little support for the hypothesis that strong endogenous responses to the currency union have been a major factor in explaining the durability of the CFA currency bloc. Even more, the OCA literature seems to provide no clear evidence of the readiness of the CFA members to have established a lasting and well functioning currency union. What is surprising is that, despite failing to meet many of these criteria, those countries have successfully maintained a currency union for several decades.

### 5.2.2 Sustainability and real exchange-rate behavior

In order to solve this puzzle, we adopt an alternative approach focusing on the sustainability of the CFA zone rather than on its optimality. Indeed, while the CFA zone cannot be qualified as an optimal currency area, its durability over time tends to show that it has been at least sustainable. Our aim is thus to understand why this monetary agreement has been economically viable, which can be considered as a necessary condition to the maintenance of the agreement. In this respect, one striking feature of the CFA countries is that they have been able to adjust to the instability generated by heavy reliance on agricultural products and raw materials, without using the nominal exchange rate as an instrument of adjustment, except for the CFA franc devaluation in 1994.

Figures 5.1 and 5.2 in the Appendix report the evolution of the real (REER) and nominal (NEER) effective exchange rates for the CFA zone countries and for a sample of sub-Saharan African countries. Three periods can be distinguished. From the mid 1980s to

1993, REERs in almost all CFA countries appreciated, stemming from an appreciating trend of their nominal effective exchange rates primarily caused by the appreciation of the French franc vis-à-vis the US dollar (Elbadawi and Majd, 1996; Coleman, 2008), and from a real depreciation of their main trade African partners. This trend was reversed with the devaluation of the CFA franc in 1994 that allowed REERs to depreciate and to stabilize. From 2000 to 2009, NEERs again appreciated along with the appreciation of the euro, leading to an appreciating trend also for the REER. Compared to the CFA zone, the non-CFA countries enjoyed less stable real effective exchange rates over the period considered. Indeed, mainly in response to a fall in their terms of trade, deep devaluations occurred in those countries (Broda, 2004) and led to a much higher variation in real exchange rates (Figure 5.2).

However, the higher stability of real and nominal exchange rates of the CFA zone does not allow concluding whether the currency union has fostered the adjustment of domestic and external sectors of those countries. Indeed, small price adjustments may have occurred over the period, leading to relatively stable real effective exchange rates at the expense of unstable outputs. In order to handle this issue, we rely on equilibrium exchange rates approaches, which involve establishing whether real exchange rates dynamics have been consistent with the equilibrium paths of economies. In this respect, an exchange-rate regime in which the convergence process of real exchange rates toward their equilibrium level is effective can be considered as fostering internal and external balances and/or facilitating the adjustment to shocks and then be qualified as sustainable.

We rely on the Behavioral Equilibrium Exchange Rate (BEER) approach which allows the real exchange rate to fluctuate around a time-varying equilibrium value. In this approach, the equilibrium real exchange rate corresponds to the real exchange rate that ensures the internal and the external equilibrium of an economy (Edwards, 1989). Its equilibrium path is then driven in the long run by its relationship with a set of long-run fundamentals. Moreover, as our focus is to evaluate the convergence process of real exchange rates towards equilibrium, this approach is more appropriate than the Fundamental Equilibrium Exchange Rate (FEER) approach as the short-run dynamics of real exchange rates can be captured by a vector error correction model derived from this long-term relationship. Thus the BEER approach allows addressing explicitly the issue of the dynamics of real exchange-rate adjustment and their speed of convergence towards equilibrium (Soto and

Elbadawi, 2008).

## 5.3 Assessing the sustainability of the CFA zone

Following the framework developed by Coudert et al. (2011) for commodity producers, we consider a BEER model that includes relevant determinants of real exchange rates for CFA and other SSA countries: (i) a Balassa-Samuelson effect to account for productivity differences across countries, (ii) the net foreign asset position in percentage of GDP as a proxy for the external balance, and (iii) terms of trade.

The long-run value of the REER is thus represented by the following equation:

$$reer_{i,t} = \mu_i + \beta_1\, prod_{i,t} + \beta_2\, nfa_{i,t} + \beta_3\, tot_{i,t} + \epsilon_{i,t} \tag{5.1}$$

where subscripts $i$ ($i = 1, \ldots, N$) and $t$ ($t = 1, \ldots, T$) respectively represent country and time indices. $reer_{it}$ is country $i$'s real effective exchange rate, $prod_{it}$ its PPP GDP per capita relative to its trade partners, $nfa_{it}$ its net foreign asset position in percentage of GDP, and $tot_{it}$ its terms of trade. $\epsilon_{i,t}$ is an error term and $\mu_i$ accounts for country-fixed effects. All variables are expressed in logarithm, except the net foreign asset position.

### 5.3.1 Data

We consider yearly data over the 1985-2009 period for two samples of countries:

- The panel of CFA countries that includes the following 13 economies: Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Equatorial Guinea, Gabon, Mali, Niger, Senegal, and Togo.[10]

- The panel of other SSA countries including—given data considerations—15 economies: Botswana, Burundi, Congo Democratic, Gambia, Ghana, Malawi, Mauritius, Mauritania, Mozambique, Nigeria, Rwanda, Sierra Leone, Sudan, Uganda, and Zambia.

[10]Guinea Bissau is not taken into account because it has been a member of WAEMU only since 1997.

The real effective exchange rate for each country $i$ is calculated as a weighted average of real bilateral exchange rates against the ten main $i$'s trading partners. Bilateral rates are derived with consumer price indices. The weights are extracted from the DOTS database of the International Monetary Fund (IMF), they are normalized to sum to one, and correspond to the average share of each partner in imports and exports of goods and services over the 1996-2009 subperiod. Nominal exchange rates and consumer price indices are taken from the World Development Indicators (WDI) database (World Bank).

The proxy for the Balassa-Samuelson effect corresponds to the real PPP GDP per capita of country $i$ relative to its ten main trading partners, using the same weights as for the calculation of the REER series. PPP GDP per capita series are extracted from WDI. The net foreign asset position for each country $i$ is extracted from the updated and extended version of dataset constructed by Lane and Milesi-Ferretti (2007), and expressed as a percentage of the country $i$'s corresponding GDP (source of GDP data: IMF, WEO database and WDI). Turning to the terms of trade, we follow Cashin et al. (2004) and Coudert et al. (2011). For each country, terms of trade are a weighted average price of the three main commodities exported by the country deflated by the unit value of OECD countries' manufactured exports. The weights of each commodity in the countries' exports are calculated from the International Trade Center database over the 2001-2009 period,[11] and commodity price data are taken from IMF, WEO database.

### 5.3.2 Panel unit root and cointegration tests

Before estimating Equation (5.1), we have to determine the order of integration of each variable and then to test the existence of a cointegrating relationship between the REER and its fundamentals. To this end, we rely on recent panel unit root and cointegration tests. More specifically, we consider third generation tests that allow accounting for both cross-sectional dependencies and structural breaks in the series. Accounting for these characteristics is particularly important in our context. Indeed, given that the considered countries are likely to share similar properties—especially those of the CFA zone—not accounting for potential cross-section correlations may lead to important size distortions (Pesaran, 2004). In addition, various countries of our sample have undergone breaks in the dynamics of their real exchange rates, such as the devaluation of the CFA franc in 1994. It

[11] See Table 5.6. in Appendix.

is thus necessary to account for this property to derive reliable results when implementing the tests.

We consider the third generation panel unit root test proposed by Carrion et al. (2005). Overcoming the deficiencies of the previous generations' tests,[12] it is based on the null hypothesis of stationarity, and accounts for multiple unknown structural breaks in mean and/or in trend in the individual time series. Let $y_{i,t}$ be a stochastic process described as follows:

$$y_{i,t} = r_{i,t} + \beta_i t + \epsilon_{i,t} \tag{5.2}$$

where

$$r_{i,t} = \sum_{k=1}^{m_i} \theta_{i,k} D(T^i_{b,k})_t + \sum_{k=1}^{m_i} \gamma_{i,k} DU_{i,k,t} + r_{i,t-1} + u_{i,t} \tag{5.3}$$

$r_{i,t}$ is a random walk with deterministic components, $u_{i,t}$ is i.i.d $(0,\sigma^2_{u,i})$, $\epsilon_{i,t}$ is i.i.d $(0,\sigma^2_{\epsilon,i})$, $u_{i,t}$ and $\epsilon_{i,t}$ are supposed to be independent, $i$ denoting the individual dimension and $t$ the time dimension of the panel. The deterministic components $D(T^i_{b,k})_t$ and $DU_{i,k,t}$ are dummy variables defined respectively as 1 for $t = T^i_{b,k}$ and 0 otherwise, and 1 for $t > T^i_{b,k}$ and 0 otherwise, with $T^i_{b,k}$ the $k$-th date of the break for the $i$-th individual, $k = 1, ..., m_i$, and $m_i \geq k$; $m_i$ being the maximum number of structural breaks.
Under the null hypothesis of stationarity, $\sigma^2_{u,i} = 0$, and the model can be written as follows:

$$y_{i,t} = r_{i,0} + \sum_{k=1}^{m_i} \gamma_{i,k} DU_{i,k,t} + \beta_i t + \sum_{k=1}^{m_i} \theta_{i,k} DT^*_{i,k,t} + e_{i,t} \tag{5.4}$$

where $e_{i,t} = \sum_{j=1}^{t} u_{i,t} + \epsilon_{i,t}$; with $DT^*_{i,k,t} = t - T^i_{b,k}$ for $t > T^i_{b,k}$ and 0 otherwise. Consequently, if $\sigma^2_{u,i} = 0$ then $e_{i,t} \equiv \epsilon_{i,t}$ and $y_{i,t}$ is stationary, otherwise $y_{i,t}$ is integrated. Two models are encompassed in this general specification. The first one—"model with constant"—is a model with individual effects and shifts in the mean. In this case, the coefficients of trend variables must be equal to zero ($\beta_i = \gamma_{i,k} = 0$). The second model—"model with

[12]For details about previous generations' panel unit root tests, see Banerjee (1999) and Hurlin and Mignon (2007) among others.

constant and trend"—also includes temporal effects and shifts in the individual time trend. In this model, the coefficients of trend variables are different from zero ($\beta_i \neq 0$ and $\gamma_{i,k} \neq 0$).

The test statistic $Z(\lambda)$ is given by:

$$Z(\lambda) = \frac{\sqrt{N(LM(\lambda) - \overline{\xi})}}{\overline{\zeta}} \tag{5.5}$$

where $LM(\lambda)$ is the LM statistic proposed by Carrion et al. (2005), depending on the structure of the long-run variance of the residuals which can be homogeneous or heterogeneous.[13] $\lambda$ represents the dates of breaks that differ from one country to another. The parameter $\overline{\xi}$ is the simple mean of $N$ individual mean values ($\xi_i$) of a standard Brownian motion, and $\overline{\zeta^2}$ is the simple mean of $N$ corresponding individual variances ($\zeta^2$). Under the null hypothesis, $Z(\lambda)$ follows weakly a standard normal distribution.

Table 5.1 displays the results of Carrion et al. (2005)'s unit root test for CFA and other SSA countries. Our findings clearly show that the null hypothesis of stationarity is rejected for all variables.

Table 5.1: **Unit root tests for CFA zone and other SSA countries**

| Variables | CFA | | Other SSA | |
|---|---|---|---|---|
| | *With constant* | *With constant and trend* | *With constant* | *With constant and trend* |
| *Reer* | 7.333*** | 18.571*** | -0.130 | 5.921*** |
| *Prod* | 4.314*** | 17.847*** | 9.193*** | 8.256*** |
| *Nfa* | 3.506*** | 15.915*** | 8.141*** | 15.381*** |
| *Tot* | 7.882*** | 8.683*** | 6.445*** | 32.007*** |

Notes: ***, **, * indicate the rejection of the null hypothesis of stationarity at the 1%, 5% and 10% significance level respectively.$m_i = 2$, and the optimum break point is chosen by considering the modified Schwarz information criterion (LWZ) of Liu, Wu and Zidek (1997). The homogeneous long-run variance case is retained for assessing the LM statistics.

We now proceed to test the existence of a long-run relationship between the REER and its

[13]For details, see Carrion et al. (2005). Using Monte Carlo experiments, the authors show that the LM statistic with homogeneous long-run variance is more relevant for small sample sizes. Accordingly, we only provide results for the homogeneous variance case. Complete results are available upon request to the authors.

fundamentals. To this end, we follow the methodology proposed by Basher and Westerlund (2009) consisting in applying a third generation unit root test on the residuals of the estimated cointegrating relationship.[14] Consequently, we first estimate Equation (5.1)—with and without trend—for the CFA zone and other SSA countries using the panel fixed-effect estimator (within), and then apply Carrion et al. (2005)'s unit root test to the corresponding residuals.

As shown in Table 5.2, there exists a stable long-run relationship between real effective exchange rates and their fundamentals for the two samples of countries.

Table 5.2: **Cointegration tests for CFA zone and other SSA countries**

| | CFA | | Other SSA | |
|---|---|---|---|---|
| | *With constant* | *With constant and trend* | *With constant* | *With constant and trend* |
| *Statistic* | 0.031 | 1.559* | 0.080 | -0.546 |
| *p-value* | 0.487 | 0.059 | 0.468 | 0.707 |

Notes: see Table 5.1.

### 5.3.3 Adjustment of real exchange rates to their equilibrium level

We now proceed to the estimation of Equation (5.1) and analyze the adjustment speed of real exchange rates to their equilibrium value. We consider the following error-correction model, which is a re-parameterization of an ARDL(p,q)[15] model:

$$\Delta reer_{i,t} = \theta_i(reer_{i,t-1} - \beta_{0,i} - \beta_i^{'} x_{i,t} + \sum_{j=1}^{p} \lambda_{i,j}^{'} x_{i,t-j} + \epsilon_{i,t} \tag{5.6}$$

where $\theta_i$ is the error-correction term measuring the speed of adjustment, $x_{i,t}$ is the $k \times 1$ (here $k = 3$) vector of explanatory variables, and $\beta_i$ and $\delta_i$ respectively denote the long-run

[14] According to Basher and Westerlund (2009), this method is very similar to the one proposed by Westerlund (2005). It has the advantage of not requiring an efficient estimator of the cointegration vector under the null (see Basher and Westerlund, 2009). In addition, it allows us to apprehend the stability of the cointegrating relationship.

[15] ARDL: autoregressive distributed lag. Given the time dimension of our panel, we retain $p = 1$, and $q \leq 1$.

and short-run coefficients.

We may expect that the substantial 1994 devaluation of the CFA franc and deep depreciations occurring in other SSA countries altered the adjustment process of real exchange rates. To test those hypotheses, Equation (5) is also estimated by considering three additional variables: (i) the dummy DUM94 which accounts for the sharp devaluation of the CFA franc in 1994 for the CFA zone, (ii) a dummy variable DUM for the other SSA countries to account for specific deep devaluations—of the same magnitude as the devaluation of the CFA franc (i.e. a depreciation of nominal effective exchange rate higher than 50%)—that have characterized those countries, and (iii) the variation of the NEER to account for the influence of the exchange-rate regime.

To estimate Equation (5.1) and its variants, we use the pooled mean group (PMG) estimator developed by Pesaran et al. (1999) which provides consistent estimation of the coefficients. Compared to other techniques—Fully-Modified OLS or Dynamic OLS, for instance—this estimator has the advantage to allow the short-run coefficients to differ freely across countries while the long-run coefficients are restricted to be the same for all individuals. Results are summarized in Table 5.3.[16]

Let us first consider the standard specifications defined by Equation (5.1) and displayed in columns (1) and (4). For the CFA countries, the coefficients of the long-run relationship are statistically significant and their signs are consistent with what is expected: an increase in terms-of-trade leads to an appreciation of the equilibrium exchange rate. The results also confirm the existence of the Balassa-Samuelson effect in the CFA zone, since an increase of the relative GDP per capita implies an appreciation of the equilibrium exchange rate. Finally, an improvement of the net foreign position also causes the equilibrium exchange rate to appreciate. The results for the other SSA countries in the long run show the absence of a terms-of-trade effect since the associated coefficient is non significant, and a weak Balassa-Samuelson effect—the corresponding coefficient being significant only at the 10% level. Finally, only the net foreign position exerts in the long run a positive impact on the real effective exchange rate. Regarding the convergence speed of real exchange rates towards equilibrium, the correction of half of real exchange-rate deviations requires on average 3.5 months more for the other SSA countries than for the CFA zone countries. Thus, despite pegged exchange rates, real exchange rates adjust more quickly in the CFA

[16]We only report the estimates of the long-run part of the model.

Table 5.3: **PMG estimations**

| | CFA countries | | | Other SSA countries | | |
|---|---|---|---|---|---|---|
| Variables | (1) | (2) | (3) | (4) | (5) | (6) |
| Prod | 0.425*** | 0.375*** | 0.069* | -0.263* | -1.060*** | -1.234*** |
| | (0.094) | (0.083) | (0.041) | (0.153) | (0.198) | (0.218) |
| Nfa | 0.217*** | 0.100** | -0.013 | 0.409*** | 0.114** | 0.346*** |
| | (0.050) | (0.043) | (0.041) | (0.054) | (0.052) | (0.072) |
| *Tot* | 0.097** | 0.096** | 0.192*** | -0.003 | 0.530*** | 0.856*** |
| | (0.044) | (0.041) | (0.042) | (0.058) | (0.083) | (0.086) |
| E-C | -0.328*** | -0.229*** | -0.190*** | -0.286*** | -0.187*** | -0.075 |
| | (0.047) | (0.042) | (0.024) | (0.038) | (0.059) | (0.053) |
| DUM | | | | | -0.212** | |
| | | | | | (0.087) | |
| $\Delta neer$ | | | 0.658*** | | | 0.585*** |
| | | | (0.020) | | | (0.092) |
| DUM94 | | -0.330*** | | | | |
| | | (0.025) | | | | |
| *Constant* | 1.801*** | 1.210*** | 0.744*** | 1.252*** | -0.149** | -0.174 |
| | (0.264) | (0.219) | (0.092) | (0.172) | (0.070) | (0.184) |
| Half-life deviation deviation | 1.744 | 2.665 | 3.289 | 2.058 | 3.348 | - |
| Observations | 312 | 312 | 312 | 360 | 360 | 360 |

Notes: Standard errors are given in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
E-C denotes the error-correction term.

zone, going in favor of the sustainability of this zone.

Let us now investigate whether this adjustment process stems mainly from the behavior of fundamentals or from changes in nominal exchange rates. Accounting for the dummies DUM94 and DUM (columns (2) and (5)), our results still hold: the adjustment speed of real exchange rates is obviously slower in the two areas, but it is still faster in the CFA zone (0.229) compared to other SSA countries (0.187). Moreover, despite taking into account the effects of strong devaluations or depreciations, the adjustment—while slower—remains significant, suggesting that the convergence process of real exchange rates towards equilibrium mainly stems from the behavior of economic fundamentals.

To investigate more deeply this issue, we finally account for the effects of the exchange-rate policy by replacing the dummy variables by changes in nominal effective exchange rates. Results, displayed in columns (3) and (6), show that the error-correction term remains significant, confirming the key role played by economic fundamentals in the exchange-rate adjustment process in the CFA zone. This may explain why the real appreciation of the CFA franc, in the last decade, did not translate into real exchange rate overvaluation for the whole zone (see Abdih and Tsangarides, 2010; and Couharde et al., 2011). In contrast, for the other SSA countries, the adjustment of real exchange rates is mainly driven by movements of the nominal exchange rate, as shown by the error-correction term which is no more significant.

Overall, our findings put forward important differences between CFA and other SSA countries. In the CFA zone, real exchange rates converge toward their equilibrium level faster than in other SSA countries. These results are not surprising as they have been already evidenced for industrialized and developing countries. Rogoff (1996) observes that the speed of real exchange rate adjustment has been particularly slow among industrialized countries while their exchange rates were floating. Cheung and Lai (2008) show that there is no significant evidence that greater nominal rate flexibility tends to yield faster real rate adjustment in developing countries. We evidence also that fundamentals play a key role in the convergence process for the CFA economies, while the adjustment toward equilibrium is mainly driven by the exchange-rate policy in the other SSA countries. These contrasted responses corroborate the findings of Broda (2004). Using a panel VAR, he evidences that, in the 1980s, African countries with flexible regimes buffered against negative terms of

trade shocks by large nominal depreciations, while the response in those with fixed regimes stemmed from the fall in domestic prices. Another explanation, and usually omitted by the OCA literature, could come from the role played by France's aid. As highlighted by Yehoue (2006), negative terms of trade shocks in the CFA zone have been generally accompanied by an increase in France's aid, suggesting the role of the anchor country in absorbing a part of those shocks. The CFA zone thus appears as a monetary area in which internal and external balances are fostered and adjustments facilitated, compared to other SSA countries. In this respect, the CFA zone can be considered as a sustainable area which has ensured the durability of the exchange-rate commitment over time despite failing to meet many of OCA criteria.

It is worth noting that our analysis has concerned the convergence process of real exchange rates for the whole CFA zone. To provide a complete analysis, we have now to investigate whether the sustainability found at this aggregated level still holds at an individual level or instead reflects a simple statistical *artefact*.

## 5.4 Further investigation on the sustainability of the CFA zone

### 5.4.1 Assessing the sustainability: a country-by-country analysis

In addition to analyzing differences in adjustment speed of real exchange rates between CFA zone countries and non-CFA ones, we replicate the same analysis on a country-by-country basis for the CFA zone. Accordingly, we rely on the PMG estimator which allows short-run coefficients, speed of adjustment and error variances to differ across countries. As before, the significance and the size of error-correction coefficients are used as proxies of the sustainability of the currency area. For each member country, a non-significant error-correction term is interpreted as indicating that the CFA franc agreements are not sustainable, while the existence of mean-reverting real exchange rates reflects instead their suitability.

Table 5.4 presents the estimated coefficients of the error-correction term and half-life (in years) for each CFA member country. As previously, we consider the three following spec-

ifications: (i) a model where effects of exchange-rate policies are omitted (column 1), (ii) a specification that takes into account the CFA franc devaluation (column 2), and (iii) a specification accounting for changes in nominal effective exchange rates (column 3).

The results show a systematic pattern for each CFA country which is, in addition, similar to the CFA zone as a whole. Indeed, the adjustment of real exchange rates, while being lower in column (3) than in columns (1) and (2) (except for Equatorial Guinea), remains significant when changes in nominal exchange rates are taken into account. Overall, these results strengthen our previous findings of a strong sustainability of the CFA zone as significant mean reversion in real exchange rates still hold for each of the member countries.

### 5.4.2 Investigating inter-country differences

Obviously, our findings also evidence a speed of adjustment of real exchange rates that varies across CFA countries. In order to investigate how much the observed inter-country variation stems from inter-country differences in structural economic characteristics, we isolate the main factors of heterogeneity within the CFA zone, as highlighted by the OCA literature, that may influence the behavior of real exchange rates: degree of openness, pattern of specialization (oil-exporting or importing country, single-commodity exporter or diversified economy) and inflation dynamics. Thus, instead of using variables suggested by the OCA theory to categorize each country as good or bad candidate in forming an OCA and delimitate the optimal perimeter of the CFA zone, we rather mobilize them in order to explain observed adjustment speeds.

The inter-country differences could first arise from the degree of openness. Indeed, the higher the degree of openness, the more changes in international prices are transmitted to domestic prices (McKinnon, 1963), and the more real exchange rates of pegged currencies are expected to adjust. To ascertain whether openness to trade facilitates real exchange-rate adjustment, the degree of trade openness reported in Table 5.5 is measured by the average ratio of total trade (imports plus exports) to the country's GDP over the 1985-2009 period. A second factor accounting for the inter-country differences is the specialization pattern that is not neutral regarding the impacts exerted by shocks. As pointed by Kenen (1969), diversification is expected to reduce the need for real adjustments via the nominal exchange rate and tends to insulate economies against a variety of disturbances. We assess

Table 5.4: **Error-correction term and half-life (in years), CFA zone country-by-country estimations**

| Country | Error-correction term and half-life (in years) | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Benin | -0.497*** | -0.356*** | -0.131** |
| | 1 | 1.58 | 4.93 |
| Burkina Faso | -0.15* | -0.044 | -0.086*** |
| | 4.26 | - | 7.7 |
| Cameroon | -0.577*** | -0.411*** | -0.242** |
| | 0.8 | 1.31 | 2.5 |
| Central African Rep. | -0.503*** | -0.226*** | -0.211*** |
| | 1 | 2.7 | 2.92 |
| Chad | -0.363*** | -0.218** | -0.136** |
| | 1.53 | 2.82 | 4.74 |
| Congo (Rep. of) | -0.51*** | -0.519*** | -0.292*** |
| | 0.97 | 0.95 | 2 |
| Côte dŠIvoire | -0.371*** | -0.239*** | -0.167*** |
| | 1.5 | 2.54 | 3.79 |
| Equatorial Guinea | -0.093** | -0.092*** | -0.377*** |
| | 7.1 | 7.2 | 1.46 |
| Gabon | -0.148** | -0.117* | -0.091** |
| | 4.32 | 5.57 | 7.3 |
| Mali | -0.244*** | -0.185*** | -0.232*** |
| | 2.49 | 3.39 | 2.62 |
| Niger | -0.241** | -0.14* | -0.165*** |
| | 2.51 | 4.6 | 3.84 |
| Senegal | -0.119 | -0.03 | -0.105** |
| | - | - | 6.25 |
| Togo | -0.446*** | -0.404*** | -0.236*** |
| | 1.17 | 1.34 | 2.57 |
| CFA | -0.328*** | -0.229*** | -0.190*** |
| | 1.74 | 2.66 | 3.29 |

Notes: *,**,*** denotes the significance at respectively 10%, 5% and 1% level. Results are extracted from models (1), (2), and (3) presented in Table 5.3. For each country, the first line reports the estimated error-correction term, and the second line the corresponding half-life in years.

these specialization patterns by isolating the main export sectors, and by classifying countries between net oil exporters and importers (see Table 5.5). It should be recalled that path-dependent patterns of specialization characterize the CFA zone, dating back to the colonialist period: CFA member countries had to furnish raw materials to the metropolitan France, as well as outlets to its manufactured products (Marseille, 1984). This special form of trade has exacerbated the role played by natural resource endowments in specialization patterns, making most of CFA member countries weakly diversified economies. Finally, as currencies are pegged, external imbalances must be corrected by internal adjustment, and the speed with which domestic prices can adjust may be a critical factor (Friedman, 1953). For price stickiness variable, we use the findings of Coleman (2011) which evidence long memory in non-food price inflation for Burkina Faso, Chad, Côte d'Ivoire, Gabon, Niger and Senegal, and in food price inflation for Chad, Cote d'Ivoire and Niger over the 1989:11–2002:09 period.

As shown in Table 5.5, a direct link between real exchange-rate adjustment speed and price stickiness is evidenced: as expected, real exchange rates in the CFA zone adjust more slowly in countries where price dynamics has been more persistent. But, even for CFA countries that experienced persistence in their inflation dynamics, the convergence process of their real exchange rates toward equilibrium still remains effective.

While no general conclusion emerges from the analysis of the openness degree, differences in adjustment speeds can also be attributed to inter-country differences in specialization patterns. More specifically, regarding the figures displayed in Tables 5.5 and 5.7. in Appendix, countries which are characterized by slow adjustment speeds are primarily specialized in agricultural products and/or weakly diversified. This is typically the case of Burkina Faso and Benin for which the share of the agricultural sector in the total good exports is very high (82% for Burkina Faso, 75% for Benin). Regarding Gabon, its low adjustment speed may be linked to its weak diversification, being mainly fuel-exporting country. On the contrary, countries for which the adjustment speed tends to be higher are more diversified in the sense that they are not single-commodity exporters: Central African Republic, Mali, Togo, Cameroon, and to a lesser extent Equatorial Guinea.

Table 5.5: **Inter-country differences in structural economic characteristics**

| Countries | Error-cor. term | Openness degree | | Specialization patterns | | Inflation persistence |
|---|---|---|---|---|---|---|
| Burkina Faso | -0.086*** | 72.1 | Net oil importer | agricultural (82%) | - | Non-food price persistence |
| Gabon | -0.091** | 139.7 | Net oil exporter | fuels (76%) | - | Non-food price persistence |
| Senegal | -0.105** | 82.4 | Net oil importer | agricultural (42%) | manufactured (32%) | Non-food price persistence |
| Benin | -0.131** | 35.7 | Net oil importer | agricultural (75%) | - | Non-food price persistence |
| Chad | -0.136** | 112.2 | Neither | agricultural (54%) | fuels (41%) | Food and non-food price persistence |
| Niger | -0.165*** | 61.7 | Neither | manufactured (38%) | agricultural, mining (22%) | Food price price persistence |
| Côte d'Ivoire | -0.167*** | 60.6 | Neither | agricultural (61%) | manufactured, fuels (19%) | Food and non-food price persistence |
| **CFA** | **-0.190*** ** | | | | | |
| Central African Rep. | -0.211*** | 41.7 | Net oil importer | pearls, gold (45%) | agricultural (40%) | No inflation persistence |
| Mali | -0.232*** | 41.7 | Net oil importer | agricultural (59%) | pearls, gold (31%) | No inflation persistence |
| Togo | -0.236*** | 95.9 | Net oil importer | agricultural (39%) | manufactured (30%) | No inflation persistence |
| Cameroon | -0.242** | 116.0 | Net oil exporter | fuels (45%) | agricultural (43%) | No inflation persistence |
| Congo (Rep. Of) | -0.292*** | 93.3 | Net oil exporter | fuels (82%) | - | No inflation persistence |
| Equatorial Guinea | -0.377*** | 66.6 | Net oil exporter | fuels (81%) | agricultural (15%) | No inflation persistence |

Notes: The error-correction term corresponds to the specification (3) in Table 5.4 which accounts for changes in NEER. The classification between oil exporters and importers is based on the sign of the differential between oil exports and imports during the 1995-2009 period (UNCTAD database). When the sign is positive, the country is a net exporter, when it is negative the country is net importer. "Neither" signals that country is oil exporter or oil importer depending on the years. The degree of trade openness corresponds to the mean ratio of total trade (imports plus exports) to the country's GDP over the 1985-2009 period. Specialization patterns are based on data representing the share of each sector in the total good exports, extracted from the CNUCED database for the 1995-2009 period (see Table 5.6 in Appendix). Member states that exhibit long memory in food and non-food price inflation are characterized by inflation persistence (Coleman, 2011).

## 5.5 Conclusion

In this chapter, we argue that the CFA countries constitute a puzzle from the standpoint of OCA analysis. They have successfully maintained a currency union despite their failure to meet a number of important OCA criteria. This can be explained by several drawbacks of the OCA analysis, the stronger coming from its "problem of inconclusiveness" and its omission of political considerations. In this respect, optimality may lead to too restrictive criteria for monetary unions that have been formed rather on political than economical considerations, as the CFA zone.

We then suggest an alternative approach which focuses on the sustainability of the CFA zone rather than on its optimality. A sustainable currency area is defined as a monetary union that impedes its member countries to deviate permanently from their equilibrium paths. We test this hypothesis by assessing the convergence process of real exchange rates towards equilibrium for the CFA zone countries and a sample of other sub-Saharan African (SSA) countries in a framework consistent with the behavioral equilibrium exchange rate approach. Our findings support the view that the CFA zone is sustainable as real exchange rates tend to revert to their equilibrium paths, while in other SSA countries this adjustment process is mainly driven by movements in nominal exchange rates. This result evidenced for the whole zone still holds for each member country, suggesting that adjustments of real exchange rates have been facilitated, at both regional and country levels.

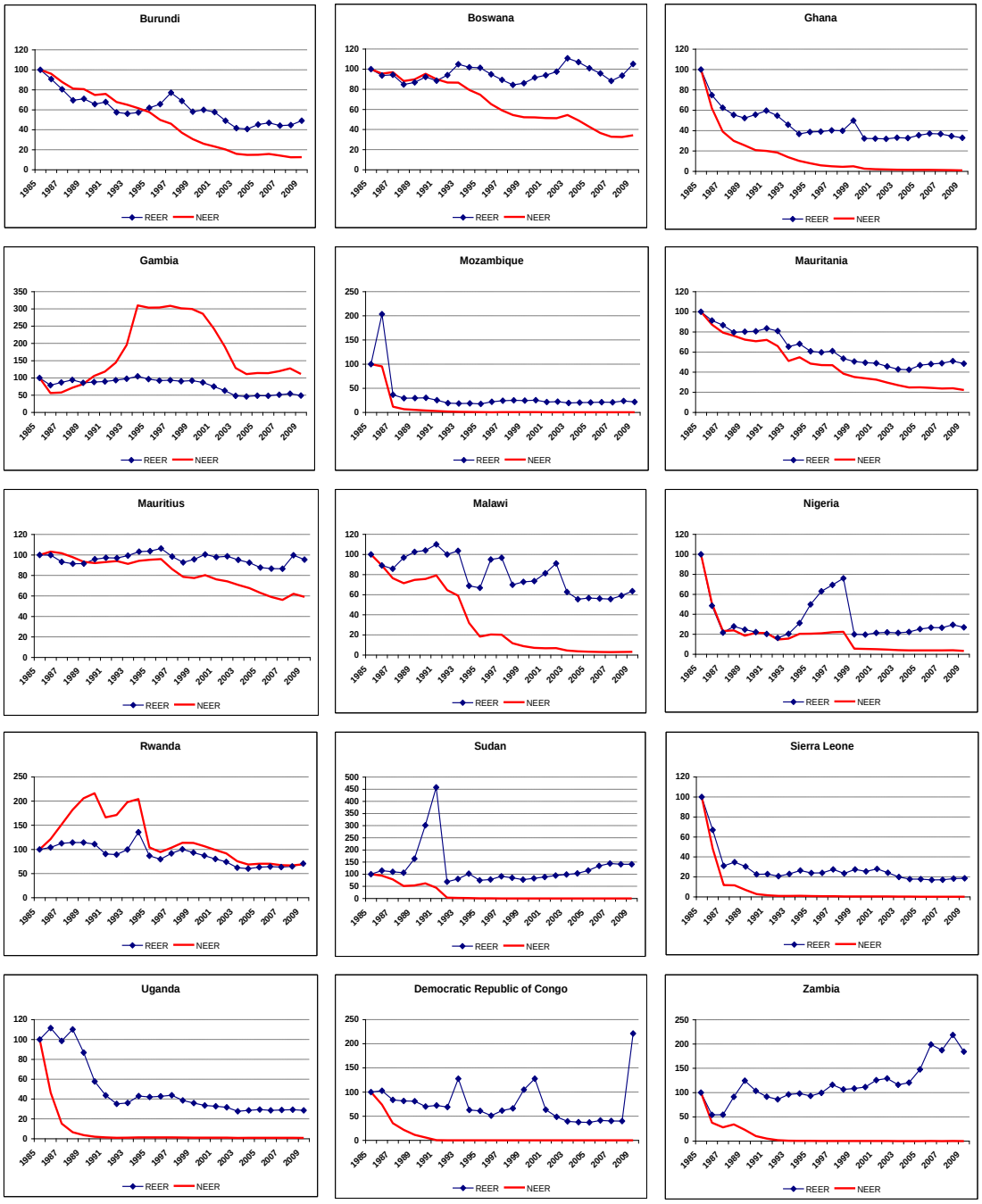
Finally, our findings at a country-by-country level show that inter-country differences can be attributed to heterogeneity in both specialization patterns and inflation persistence. While this heterogeneity is often put forward to reject the optimality of the CFA zone, we evidence that it does not act as a brake regarding the adjustment of real exchange rates. Indeed, the convergence process of real exchange rates towards equilibrium has been at work even in countries which exhibit most factors of rigidity (specializations in agricultural products and/or weakly diversified, persistence in inflation dynamics). This explains why the CFA zone can be more accurately described as a sustainable currency area rather than an optimal one.

## 5.6 Appendix

Figure 5.1: **Evolution of the real (REER) and nominal (NEER) effective exchange rates, CFA zone countries, 1985-2009**


Note: A rise points to an appreciation.

Figure 5.2: **Evolution of the real (REER) and nominal (NEER) effective exchange rates, other SSA countries, 1985-2009**




Note: A rise points to an appreciation.

Table 5.6: **Main commodity exports and their share in total exports, 2001-2009**

| Country | Main exports | | | Share of exports in % | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 |
| *CFA countries* | | | | | | |
| Benin | Cotton | Nuts | Petroleum | 42 | 9 | 8 |
| Burkina Faso | Cotton | Gold | Oil seed | 56 | 17 | 8 |
| Cameroon | Petroleum | Hardwood logs | Cocoa | 44 | 14 | 10 |
| Central African Rep. | Diamonds | Hardwood logs | Hard Sawn wood | 57 | 22 | 12 |
| Chad | Petroleum | - | - | 94 | - | - |
| Congo Rep. | Petroleum | - | - | 88 | - | - |
| Côte d'Ivoire | Cocoa | Petroleum | Rubber | 33 | 30 | 4 |
| Equatorial Guinea | Petroleum | - | - | 95 | - | - |
| Gabon | Petroleum | - | - | 84 | - | - |
| Mali | Gold | Cotton | Beef | 68 | 20 | 3 |
| Niger | Uranium | Gold | Beef | 47 | 7 | 6 |
| Senegal | Petroleum | Phosphate rock | Fish | 24 | 17 | 16 |
| Togo | Phosphate rock | Cotton | Iron ores | 40 | 12 | 8 |
| *Other SSA countries* | | | | | | |
| Botswana | Diamonds | Copper | Nickel | 72 | 6 | 5 |
| Burundi | Gold | Coffee | Tea | 40 | 28 | 3 |
| Congo Democratic | Diamonds | Copper ores | Petroleum | 33 | 17 | 11 |
| Gambia | Ground-nut oil | Sea food | Ground nut | 12 | 10 | 10 |
| Ghana | Gold | Cocoa | Plywood | 42 | 29 | 3 |
| Malawi | Tobacco | Sugar | Tea | 58 | 10 | 7 |
| Mauritius | Sugar | Sea food | Diamonds | 29 | 18 | 4 |
| Mauritania | Iron ores | Fish | Petroleum | 54 | 28 | 10 |
| Mozambique | Aluminum | Electrical energy | Shrimp | 50 | 9 | 5 |
| Nigeria | Petroleum | - | - | 94 | - | - |
| Rwanda | Tea | Coffee | Tin ores | 21 | 18 | 16 |
| Sierra Leone | Diamonds | Cocoa | Aluminum | 36 | 7 | 6 |
| Sudan | Petroleum | - | - | 83 | - | - |
| Uganda | Coffee | Fish | Gold | 20 | 11 | 6 |
| Zambia | Copper | Other metal | - | 72 | 7 | - |

Sources: International Trade Center http://www.intracen.org and authors' calculations.

Table 5.7: **Specialization patterns (in %): share of each sector in total good exports**

| | *Agricultural products* | *Fuels* | *Ores and metals* | *Pearls and gold* | *Manufactured goods* |
|---|---|---|---|---|---|
| Benin | 75 | 10 | 4 | 1 | 9 |
| Burkina Faso | 82 | 2 | 0 | 4 | 12 |
| Cameroon | 43 | 45 | 5 | 0 | 7 |
| Central African Rep. | 40 | 1 | 9 | 45 | 6 |
| Chad | 54 | 41 | 0 | 0 | 5 |
| Congo | 8 | 82 | 4 | 4 | 2 |
| Côte dŠIvoire | 61 | 19 | 0 | 1 | 19 |
| Equatorial Guinea | 15 | 81 | 0 | 0 | 4 |
| Gabon | 14 | 76 | 5 | 0 | 4 |
| Mali | 59 | 1 | 0 | 31 | 9 |
| Niger | 22 | 18 | 21 | 1 | 38 |
| Senegal | 42 | 20 | 6 | 1 | 32 |
| Togo | 39 | 10 | 18 | 2 | 30 |

Notes: authors' calculations based on data extracted from the UNCTAD database.

# Conclusion Générale

La crise de la dette souveraine en zone euro montre combien une union monétaire hétérogène et inachevée est vulnérable et soumise à des tensions d'éclatement. Par ailleurs, elle est aussi venue reposer avec acuité la question toujours non résolue de la zone géographique adéquate pour une monnaie. En effet, une union monétaire induit non seulement l'abandon de politiques monétaire et de change autonomes, mais de plus, elle conditionne aussi les politiques budgétaires soulevant le problème de la convergence. Cette thèse traite ainsi le problème de la convergence par le biais des prix et des taux de change d'équilibre. Trois thèmes sont abordés : le degré d'homogénéïté de la dynamique des prix dans l'UEM, ses conséquences sur les déséquilibres macroéconomiques et ses liens avec la crise de la dette, et enfin la soutenabilité de la zone CFA.

Peu d'études analysent la convergence des prix au sein de la zone euro, bien qu'elle soit un critère essentiel à l'optimalité d'une union monétaire. Pour combler cette insuffisance, le chapitre 2 s'attache à étudier la convergence des niveaux de prix de douze pays faisant partie de l'UEM entre Janvier 1970 et Juillet 2011. En nous appuyant sur des modèles à transition lisse (STR), nous montrons que l'ajustement des prix est un processus non-linéaire qui dépend de la taille des différentiels de prix. Pour la plupart des pays, le processus de convergence n'intervient que lorsque le différentiel de prix entre membres dépasse un certain seuil. Par ailleurs, nos résultats avancent l'existence d'une certaine hétérogénéïté entre membres au niveau des vitesses d'ajustement que nous expliquons grâce à des indicateurs de compétitivité et aux schémas de spécialisation technologiques des pays. Les pays du coeur de l'Europe, à savoir l'Autriche, la Belgique, la France, et les Pays-Bas sont caractérisés par des vitesses de convergence relativement rapides par rapport à l'Allemagne, cohérentes avec leur compétitvité-prix et leur spécialisation dans les produits à haute technologie. Pour les pays périphériques tels que le Portugal et la Grèce, spécialisés dans des produits à faible technologie, les rapides vitesses de convergence dénotent principalement une baisse

de la compétitivité prix. Enfin les résultats obtenus pour l'Irlande montrent que, dans l'ensemble, ce pays a connu un effet de type Balassa/Samuelson.

Dans le chapitre 3, nous poursuivons l'étude de la dynamique des prix en testant la Parité des Pouvoirs d'Achat (PPA) grâce à des tests de racine unitaire et de cointégration en panel de deuxième et troisième générations. Nos résultats confirment l'hétérogénéïté de la dynamique des prix tant au niveau des périodes que des groupes de pays considérés. De manière générale, si la PPA est vérifiée pour les pays du coeur de la zone, cette hypothèse n'est pas validée pour les pays périphériques du Nord, comme la Finlande et l'Irlande qui paraissent avoir connu un phénomène de rattrapage. Pour les pays périphériques du Sud, l'Espagne, la Grèce et le Portugal, la PPA n'est respectée qu'avant l'introduction de l'euro.

Le chapitre 4 a pour but de déterminer si la crise de la dette dans la zone euro peut être assimilée à une crise de la balance des paiements en union monétaire déclenchée par l'hétérogénéïté de la dynamique des prix. Par l'intermédiaire du modèle CHEER, nous montrons au niveau théorique qu'un déséquilibre externe par rapport à un partenaire peut se traduire, au sein d'une zone monétaire, par une crise de la balance des paiements. En l'absence d'ajustements réels nécessaires, les déséquilibres, qui ne peuvent être jugulés par des instruments monétaires, entrainent une augmentation des différentiels de taux d'intérêts. Au niveau empirique, les résultats issus des modèles VAR cointégrés montrent qu'il existe une relation de long terme, par rapport à l'Allemagne, pour tous les pays de l'UEM (sauf pour la Finlande) entre le marché des biens et le marché des capitaux, avec une causalité unidirectionnelle partant du premier vers le second (sauf pour les Pays-Bas où la causalité est bi-directionnelle). Par ailleurs, les pays sous assistance financière internationale (Grèce, Irlande et Portugal) apparaissent plus sensibles aux déséquilibres que les autres. Cela nous conduit à penser que l'hypothèse d'une crise de la balance des paiements ne peut être rejetée pour ces pays.

Enfin, le chapitre 5 avance que les pays de la zone CFA constituent une énigme du point de vue de l'analyse des zones monétaires optimales (ZMO). Ils ont réussi à assurer la pérennité de leur union alors qu'ils ne remplissent pas un grand nombre des critères d'optimalité. Ceci peut s'expliquer par cetaines limites dans la théorie des ZMO, notamment son "caractère peu concluant" et son oubli des considérations politiques. Nous suggérons donc une approche alternative qui se concentre sur la soutenabilité plutôt que sur l'optimalité, une zone monétaire soutenable étant définie comme une union qui ne conduit pas ses membres

à dévier de manière permanente de leurs sentiers d'équilibre. Nous testons cette hypothèse par l'étude des processus de convergence des taux de change réels vers leur équilibre dans le cadre de la modélisation BEER, à la fois pour la zone CFA, mais aussi pour un échantillon de pays de l'Afrique Subsaharienne. Nos résultats confirment la soutenabilité de la zone CFA, leurs taux de change réels tendant à revenir vers l'équilibre, alors que pour les autres pays d'Afrique Subsaharienne le processus d'ajustement s'effectue principalement à travers une évolution du taux de change nominal. Ces résultats sont valables à la fois pour l'ensemble de la zone, mais aussi pour chaque membre, suggérant que les ajustements de taux de change réels ont été facilités aussi bien au niveau de la zone qu'au niveau individuel. Enfin, l'analyse par pays montre que les différences entre pays peuvent être attribuées à l'hétérogénéïté des schémas de spécialisation ainsi qu'à la persistance de l'inflation. Si l'hétérogénéïté est souvent mise en avant pour rejeter l'optimalité de la zone CFA, nous montrons qu'elle n'agit pas comme un frein à l'ajustement des taux de change réels. En effet, le processus de convergence des taux de change réels vers leur équilibre est vérifié même dans les pays présentant les plus grandes rigidités, ce qui explique pourquoi la zone CFA peut être qualifiée d'union soutenable plutôt qu'optimale.

Plusieurs extensions peuvent être proposées. Dans la poursuite du chapitre 2, un prolongement réside dans le découpage de l'analyse en différentes sous périodes, permettant ainsi de mesurer l'impact des différents systèmes monétaires sur la dynamique des prix. Le recours à un modèle WS-PS permettrait en outre de déterminer si les salaires constituent la principale source d'hétérogénéïté de cette même dynamique et constituerait une extension prometteuse. Une troisième extension possible, s'inscrivant dans la lignée du chapitre 3, consisterait à corriger les niveaux de prix par les niveaux de productivité, ce qui permettrait de tester de manière plus formelle la convergence absolue.

# Bibliography

# Bibliography of General Introduction

Andersson, M., Masuch, K., and M. Schiffbauer (2009), "Determinants of inflation and price level differentials across the euro area countries", ECB Working Paper nř1129, Frankfurt: European Central Bank.

Balassa, B. (1961), "Towards a theory of economic integration", *Kyklos* 14, 1-17.

Beck, G.W., Hubrich, K. and M. Marcellino (2009), "Regional inflation dynamics within and across euro area countries and a comparison with the United States", *Economic Policy*, 24(57), 141-184.

Bini Smaghi, L. (2011), "Addressing Imbalances in the Euro Area", Speech at the Halle Institute for Economic Research, Halle an der Saale, 14 February 2011.

Bourguinat, H. (1999), *Economie Internationale*, $4^{me}$ édition, Paris: Presses Universitaires de France.

Blanchard, O. and F. Giavazzi (2002), "Current Account Deficits in the Euro Area. The End of the Feldstein Horioka Puzzle?", *Brookings Papers on Economic Activity*, 2.

Bulyr, A. and J. Hurnyk (2008), "Why has inflation in the European Union stopped converging?", *Journal of Policy Modeling*, 30, 341-347.

Bussière, M., Chudik, A. and A. Mehl (2011), "Does the Euro Make a Difference? Spatio-Temporal transmission of Global Shocks to Real Effective Exchange Rates in an Infinite VAR", ECB Working Paper n°1292, Frankfurt: European Central Bank.

Coudert, V., Couharde, C. and V. Mignon (2012), "On currency misalignments within the euro area", Working Paper EconomiX 2012-30, Nanterre.

Deustche Bank (2010), "On the problems of macroeconomic imbalances in the euro area", Monthly bulletin, July.

Égert, B. (2007), "Real convergence, price level convergence and inflation differentials in Europe", Working Paper n138, Oesterreichische Nationalbank.

Eichengreen, B.J., (2010), "Imbalances in the euro area", mimeo, University of California, Berkeley.

Fleming, M. (1971), "On exchange rate unification", *Economic Journal* 81, 467-488.

Frankel, J. and A. Rose (1998), "The endogeneity of the optimum currency area criteria",

*The Economic Journal* 108, 1009-1025.

Goodhart, C.A.E. (1998), "The two concepts of money: implications for the analysis of optimum currency areas", *European Journal of Political Economy*, 14(3), 407-432.

Haberler, G. (1970), "The International Monetary System: Some Recent Developments and Discussions", in Halm, G. (ed.) *Approaches to Greater Flexibility in Exchange Rates*, Princeton: Princeton University Press.

Hicks, J.R., (1974), *The crisis in Keynesian Economics*, Oxford: Blackwell.

Honohan, P. and P. Lane (2003), "Divergent inflation rates in EMU", *Economic Policy* 18, 357-394.

Ishiyama, I. (1975), "The Theory of Optimum Currency Areas: A Survey", *Staff Papers*, International Monetary Fund, 22, 344Ű83.

Juselius, K. (2006), *The Cointegrated VAR Model: Methodology and Applications*, Oxford: Oxford University Press.

Kalemli-Ozcan, S., Sorensen, B.E., and O. Yosha (2001), "Economic integration, industrial specialization and the asymmetry of economic fluctuations", *Journal of International Economics*, 55(1), 107-137.

Kenen, P. (1969), "The theory of optimum currency areas: an eclectic view", in R.Mundell and A. Swoboda (eds.) *Monetary Problems in the International Economy*, Chicago: University of Chicago Press.

Krugman, P. (1993a), "Lessons from Massachusetts for EMU" in Torres, F. Giavazzi, F. (ed), *Adjustment and Growth in the European Monetary Union*, Cambridge: Cambridge University Press.

Krugman, P. (1993b), "Six sceptical propositions about EMU", in A. Courakis and G.S. Tavlas (eds.), *Financial and Monetary Integration*, Cambridge: Cambridge University Press.

Krugman, P.(2012), "L'inflation n'est pas le problème, c'est la solution", *Le Monde*, 14/03/2012.

Magnifico, G. (1973), *European Monetary Unification*, Edinburgh: Mac Millan.

McKinnon, R. (1963), "Optimum currency areas", *American Economic Review* 53, 657-665.

Michalet, C.A. (1976),*Le capitalisme mondial*, Paris: Presses Universitaires de France.

Mintz, N.N. (1970), "Monetary Union and Economic Integration", *Bulletin*, New York:

New York University.

Montiel, P.K. (2009), International macroeconomics, Oxford: Wiley-Blackwell.

Mundell, R.A. (1961), "A theory of optimum currency areas", *American Economic Review* 51, 715-725.

Perroux, F. (1957), *L'Europe sans rivages*, Paris: Presses Universitaires de France.

Rabanal, P. (2009), "Inflation differentials between Spain and EMU: A DSGE perspective", *Journal of Money, Credit and Banking*, 41(6), 1142-1166.

Sénégas, M.A. (2010), "La théorie des zones monétaires optimales au regard de l'euro : Quels enseignements après dix ans d'union économique et monétaire en Europe", *Revue d'Economie Politique*, 120, 379-419.

Stiglitz, J. (2010), "L'austérité mène au désastre", *Le Monde de l'économie*, 25/05/2010.

Stiglitz, J. (2011), "L'austérité est une menace pour les démocraties", *Marianne 2*, 15/01/2011.

Tavlas, G.S. (1993), "The "new" theory of optimum currency area", *The World Economy*, 16(6), 663-685.

Teräsvirta, T. (1994), "Specification, estimation, and evaluation of smooth transition autoregressive models", *Journal of the American Statistical Association* 89(425), 208-218.

# Bibliography of Chapter 1

Balassa, B. (1961), "Towards a theory of economic integration", *Kyklos* 14, 1-17.

Baldwin, R.E. and A.J. Venables (1995), "Regional economic integration", in G. Grossman and K. Rogoff (eds.), *Handbook of International Economics*, vol. 3, Amsterdam: North Holland.

Baldwin, R.E. and C. Wyplosz (2006), *The Economics of European Integration*, Mac Graw Hill.

Banque de France (2002), "La Zone Franc", Note d'information n°127.

Barro, R. and D. Gordon (1983), "Rules, discretion and reputation in a Model of Monetary Policy", *Journal of Monetary Economics*, 12, 101-121.

Bayoumi, T. and B. Eichengreen (1993), "Shocking aspects of European monetary unifica-

tion", in F. Giavazzi and F. Torres (eds.) *The transition to economic and monetary union in Europe*, New-York: Cambridge University Press.

Bayoumi, T. and B. Eichengreen (1996), "Ever close to heaven? An optimum currency area index for European countries", *European Economic Review* 41, 761-770.

Beine, M. (1999), "L'Union Economique et Monétaire Européenne à la lumière de la théorie des zones monétaires optimales : une revue de la littérature", *Brussels Economic Review*, 162, 149-202.

Bénassy-Quéré, A. and M. Coupet (2005), "On the Adequacy of Monetary Arrangements in Sub-Saharan Africa", *The World Economy* 28, 349-373.

Blanchard, O. (2007), "Adjustment within euro. The difficult case of Portugal.", *Portuguese Economic Review*, 6(1), 1-21.

Blanchard, O. and D. Quah (1989), "The Dynamic Effects of Demand and Supply Disturbances", *American Economic Review*, 79, 655-673.

Bruno, M. and J. Sachs (1985), *Economics of worldwide stagflation*, Oxford: Basil Blackwell.

Byé, M. and G. Destanne de Bernis (1977), *Relations économiques internationales*, quatrième édition, Paris : Dalloz.

Calmfors , L. and J. Diffill (1988), "Bargaining structure, corporatism and macroeconomic performance", *Economic policy*, 6, 13-61.

De Grauwe, P. (2000), *Economics of monetary union*, Fourth Edition, Oxford: Oxford University Press.

De Grauwe, P. and W. Vanhaverbeke (1990), " Exchange rate experience of small EMS countries. The cases of Belgium, Denmark and the Netherlands', in V. Argy and P. De Grauwe (eds.), *Choosing an exchange regime*, Washington D.C.: International Monetary Fund.

De Rosa, D.A. (1998), "Regional integration arrangements: Static economic theory, quantitative findings, and policy guidelines", Policy Research Working Paper n°2007, Washington D.C.: The World Bank.

Djoufelkit, H. (2007), "Evolution des TCER de la zone franc : 1993-2008", Rapport thématique JUMBO, Paris : Agence Française de Développement.

Dufrénot, G., Houessou, E. and E. Nonfodji (2007), *Politique budgétaire et dette dans les pays de l'UEMOA*, Paris, Economica.

Dufrénot, G. and E.A. Sakho (2008), *Enjeux de politique macroéconomiques des pays de l'UEMOA*, Paris, Economica.

Eichengreen, B. (1990), "Is Europe an optimum currency area?", CEPR Discussion Paper n°478, London: CEPR.

Engel C. and J.H. Rogers (1996), "How wide is the border?", *American Economic Review*, 86(5), 1112-1125.

Fleming, M. (1971), "On exchange rate unification", *Economic Journal* 81, 467-488.

Fontagné, L. and M. Freudenberg (2002), "Long-term trends in IIT", in *Frontiers of research on intra-industry trade*, in P. Lloyd and H. Lee (eds.), Palgrave.

Frankel, J. and A. Rose (1998), "The endogeneity of the optimum currency area criteria", *The Economic Journal* 108, 1009-1025.

Frankel, J. and A. Rose (2002), "An estimate on the effect of common currencies on trade and income", *The Quarterly Journal of Economics*, 117(2), 437-466.

Friedman, M. (1953), *Essays in Positive Economics*, Chicago: University of Chicago Press.

Friedman, M. (1968), "The role of monetary policy", *American Economic Review*, 58, 1-17.

Hajimichael, M.T. and M. Galy (1997), "The CFA Franc Zone and the EMU", IMF Working Paper WP/97/156, Washington, DC: International Monetary Fund.

Horvath, J. (2003), "Optimum currency area theory: a selective review", BOFIT Discussion Paper n°15, Helsinki: Bank of Finland Institute for Economies in Transition.

Kalemli-Ozcan, S., Sørensen, B.E., and O. Yosha (2001), "Economic integration, industrial specialization and the asymmetry of economic fluctuations", *Journal of International Economics*, 55(1), 107-137.

Kenen, P. (1969), "The theory of optimum currency areas: an eclectic view", in R.Mundell and A. Swoboda (eds.) *Monetary Problems in the International Economy*, Chicago: University of Chicago Press.

Kletzer, K.M. and J. Von Hagen (2000), "Monetary union and fiscal federalism", CEPR Discussion Paper n°2615, London: Center for Economic and Policy Research.

Krugman, P. (1990), "Policy problems of a monetary union", in P. De Grauwe and L.

Papademos (eds.), *The European monetary system in the 1990s*, London: Longman.

Krugman, P. (1991), *Geography and trade*, Cambridge: MIT Press.

Krugman, P. (1993), "Lessons from Massachusetts for EMU" in Torres, F. Giavazzi, F. (eds.), *Adjustment and Growth in the European Monetary Union*, Cambridge: Cambridge University Press.

Lucas, R.E. (1972), "Expectations and the neutrality of money", *Journal of Economic Theory*, 4(2), 103-124.

Marx, K. (1867), *Le capital*, Bibliothèque de la Pléïade, Paris : NRF.

McKinnon, R. (1963), "Optimum currency areas", *American Economic Review* 53, 657-665.

Meade, J.E. (1955), *The theory of customs unions*, Amsterdam: North Holland.

Mélitz, J. (1991), "A suggested reformulation of the theory of optimum currency areas", CEPR Discussion Paper n°590, London: Center for Economic and Policy Research.

Micco, A., Stein, E. and G. Ordoñez (2003), "The currency union effect on trade: early evidence from EMU", *Economic Policy*, 18(37), 315-356.

Mongelli, F.P. (2005), "What is European Economic and Monetary Union Telling us About the Properties of Optimum Currency Areas?", *The Journal of Common Market Studies*, 43(3), 607-635.

Montiel, P.K. (2009), International macroeconomics, Oxford: Wiley-Blackwell.

Muth, J.F. (1961), "Rational expectations and the theory of price movements", *Econometrica*, 29, 315-335.

Perroux, F. (1957), *L'Europe sans rivages*, Paris : Presses Universitaires de France.

Polnayi, K. (1944), *La grande transformation*, Paris : Gallimard.

Rose, A.K. (2000), "One money, one market: the effect of currencies on trade", *Economic Policy* 15, 7-46.

Rose, A.K. et T.D. Stanley (2005), "A meta-analysis of the effect of common currencies on international trade", *Journal of Economic Surveys* 19, 347-365.

Sachs, J. and C. Wyplosz (1986), "The economic consequences of President Mitterand", *Economic Policy*, 2.

Sargent, T. and N. Wallace (1976), "Rational expectations and the theory of economic

policy", *Journal of Monetary Economics*, 2, 169-183.

Tavlas, G.S. (1993), "The "new" theory of optimum currency area", *The World Economy*, 16(6), 663-685.

Vaubel, R. (1976), "Real exchange rate changes in the European Community: the empirical evidence and its implications for the European currency unification", *Weltwirtschaftliches Archiv*, 112, 429-470.

Viner, J. (1950), *The customs union Issue*, New-York: Carnegie Endowment for Peace.

## Bibliography of Chapter 2

Allington, N.F.B., Kattuman, P.A. and F.A. Waldmann (2005), "One Market, One Money, One Price?", *International Journal of Central Banking* 1(3), 73-115.

Arnold, I.J.M and B.A. Verhoef (2004), "External causes of euro zone inflation differentials. A re-examination of the evidence", *Intereconomics* 39, 254-263.

Bartelsman, E.J. and E. Doms (2000), "Understanding productivity: lessons from longitudinal microdata", *Journal of Economic Literature* 38, 569-594.

Beck, A.A. and G.W. Weber (2005), "Price stability, inflation convergence, and diversity in EMU: does one size fit all?", Manuscript, Goethe University Frankfurt.

Camarero, M., Esteve, V. and C. Tamarit (2000), "Price convergence of peripheral countries on the way to EMU: A time series approach", *Empirical Economics* 25, 149-168.

Cecchetti, S.G., Mark, N.C. and R. Schuman (2002), "Price index convergence among United States cities", *International Economic Review* 43, 1081-1099.

Crucini, M.J., Telmer, C.I. and M. Zachariadis (2005), "Understanding European real exchange rates", *American Economic Review* 95, 724-738.

Cuaresma, J.C., Égert, B. and M.A. Silgoner (2007), "Price level convergence in Europe: Did the introduction of the Euro matter?", Monetary Policy and the Economy, 2007/01, 100-113.

Égert, B., Ritzberger-Grünwald D. and M.A. Silgoner (2004) "Inflation differentials in Europe: Past experience and future prospects", Monetary Policy and the Economy. 2004/01. 47-72.

Égert, B. (2007), "Real convergence, price level convergence and inflation differentials in Europe", Working Paper n138, Oesterreichische Nationalbank.

Engel, C. and J.H. Rogers (2004), "European product market integration after the euro", *Economic Policy* 19, 347-384.

Engle, R.F. and C.W.J. Granger (1987), "Co-integration and error correction: Representation, estimation and testing", *Econometrica* 55(2), 251-276.

Faber, R.P. and C.J. Stockman (2009), "A short history of price level convergence in theory in Europe", *Journal of Money, Credit and Banking* 41, 461-477.

Fleming, M. (1971), "On exchange rate unification", *Economic Journal* 81, 467-488.

Goldberg, P.K. and F. Verboven (2005), "Market integration and convergence to the law of one price: evidence from the European car market", *Journal of International Economics* 65, 49-73.

Honohan, P. and P. Lane (2003), "Divergent inflation rates in EMU", *Economic Policy* 18, 357-394.

Lentz, R. and D.T. Mortensen (2005), "Productivity growth and worker reallocation", *International Economic Review* 46, 731-749.

Lutz, M. (2003), "Price convergence under EMU: first estimates", Discussion Paper n°2003-08, University of Saint Gallen.

Rogers, J.H. (2007), "Monetary union, price level convergence and inflation: how close is Europe to the USA?", *Journal of Monetary Economics* 71, 259-270.

Schumpeter, J.A. (1942), *Capitalism, socialism and democracy*, Harper and Row (New-York).

Teräsvirta, T. (1994), "Specification, estimation, and evaluation of smooth transition autoregressive models", *Journal of the American Statistical Association* 89(425), 208-218.

Terävirta, T. and H.M. Anderson (1992), "Characterizing nonlinearities in business cycles using smooth transition autoregressive models", *Journal of Applied Econometrics* 7(S), S119-36.

# Bibliography of Chapter 3

Allington, N.F.B., Kattuman, P.A. and F.A. Waldmann (2005), "One Market, One Money, One Price?", *International Journal of Central Banking* 1(3), 73-115.

Arnold, I.J.M and B.A. Verhoef (2004), "External causes of euro zone inflation differentials. A re-examination of the evidence", *Intereconomics* 39, 254-263.

Balassa, B. (1961), "Towards a theory of economic integration", *Kyklos* 14, 1-17.

Bayoumi, T. and B. Eichengreen (1993), "Shocking aspects of European monetary unification", in F. Giavazzi and F. Torres (eds.) *The transition to economic and monetary union in Europe*, New-York: Cambridge University Press.

Bayoumi, T. and B. Eichengreen (1996), "Ever close to heaven? An optimum currency area index for European countries", *European Economic Review* 41, 761-770.

Braudel, F. (1985), *La dynamique du capitalisme*, Flammarion.

Camarero, M., Esteve, V. and C. Tamarit (2000), "Price convergence of peripheral countries on the way to EMU: A time series approach", *Empirical Economics* 25, 149-168.

Carrion-i Silvestre, J. L., del Barrio-Castro, T. and E. Lopez-Bazo (2005), "Breaking the Panels: an Application to the GDP Per Capita", *Econometrics Journal* 8, 159-175.

Cecchetti, S.G., Mark, N.C. and R. Schuman (2002), "Price index convergence among United States cities", *International Economic Review* 43, 1081-1099.

Chan, F. and L. Pauwels (2009), "Unit Roots and Structural Breaks in Panels: Does the Model Specification Matter?", Working Paper, University of Sydney, Australia.

Choi, I. (2002), "Combination unit root tests for cross-sectionally correlated panels", Mimeo, Hong Kong University of Science and Technology.

Crucini, M.J., Telmer, C.I. and M. Zachariadis (2005), "Understanding European real exchange rates", *American Economic Review* 95, 724-738.

Cuaresma, J.C., Égert, B. and M.A. Silgoner (2007), "Price level convergence in Europe: Did the introduction of the Euro matter?", Monetary Policy and the Economy, 2007/01, 100-113.

Égert, B., Ritzberger-Grünwald D. and M.A. Silgoner (2004) "Inflation differentials in Europe: Past experience and future prospects", Monetary Policy and the Economy. 2004/01.

47-72.

Égert, B. (2007), "Real convergence, price level convergence and inflation differentials in Europe", Working Paper n138, Oesterreichische Nationalbank.

Elliott, G., Rothenberg, T.J. and Stock, J.H. (1996), "Efficient tests for an autoregressive unit root", *Econometrica* 64, 813-836.

Engel, C. and J.H. Rogers (2001), "Deviation from Purchasing Power Parity: causes and welfare consequences", *Journal of International Economy* 55, 29-57.

Engel, C. and J.H. Rogers (2004), "European product market integration after the euro", *Economic Policy* 19, 347-384.

Faber, R.P. and C.J. Stockman (2009), "A short history of price level convergence in theory in Europe", *Journal of Money, Credit and Banking* 41, 461-477.

Frankel, J. et A. Rose (1998), "The endogeneity of the optimum currency area criteria", *The Economic Journal* 108, 1009-1025.

Gregroy, A. and B. Hansen (1996), "Residual-based tests for cointegration in models with regime shifts", *Journal of Econometrics* 70, 99-126.

Guerreiro, D. and Mignon, V. (2011), "On price convergence in Eurozone", Working Paper EconomiX, 2011-34.

Harris, D., Leybourne, S. and B. McCabe (2005), "Panel stationarity tests for purchasing power parity with cross-sectional dependence", *Journal of Business and Economic Statistics* 23, 395-409.

Honohan, P. and P. Lane (2003), "Divergent inflation rates in EMU", *Economic Policy* 18, 357-394.

Hurlin, C. (2010), "What would Nelson and Plosser find had they used panel unit root tests?", *Applied Economics* 42, 1515-1531.

Hurlin, C. and Mignon, V. (2006), "Second generation panel unit root tests", Working Papers, HAL.

Im, K.S., Lee, J. and M. Tieslau (2010), "Stationarity of Inflation: Evidence from Panel Unit Root Tests with Trend Shifts", 20th annual Meeting of Midwest Econometrics Group, Oct. 1-2 2010, Washington University at St Louis.

Juselius, K. (1995), "Do purchasing power parity and uncovered interest rate parity hold

in the long run? An example of likelihood inference in a multivariate time-series model", *Journal of Econometrics* 69, 211-240.

Juselius, K. (2003), "Wage, price, and unemployment dynamics in the convergence to PPP in the Euro Area", Discussion Paper n°03-01, Institute of Economics, University of Copenhagen.

Kenen, P. (1969), "The theory of optimum currency areas: an eclectic view", in (R.Mundell and A. Swoboda eds.) *Monetary Problems in the International Economy* Chicago, University of Chicago Press.

Lee, J. and M. Strazicich (2003), "Minimum LM Unit Root Tests with Two Structural Breaks", *The Review of Economics and Statistics* 85, 1082-1089.

McKinnon, R. (1963), "Optimum currency areas", *American Economic Review* 53, 657-665.

Mundell, R.A. (1961), "A theory of optimum currency areas", *American Economic Review* 51, 715-725.

Ng, S. and P. Perron (2001), "Lag Length Selection and the Construction of Unit Root Tests with Good Size and Power", *Econometrica* 69, 1519-1554.

Pesaran, M.H. (2004), "General diagnostic tests for cross-section dependence in panels", CESifo Working Paper, 1233, 255-260.

Pesaran, M.H. (2007), "A simple panel unit root test in the presence of cross-section dependence", *Journal of Econometrics* 22, 265-312.

Pesaran, M.H., Shin, Y. and Smith, R. (1999), "Pooled mean group estimation of dynamic heterogeneous panels", *Journal of the American Statistical Association* 94, 621-634.

Rogers, J.H. (2007), "Monetary union, price level convergence and inflation: how close is Europe to the USA?", *Journal of Monetary Economics* 71, 259-270.

Sargan, J. D. and A. Bhargava (1983), "Testing for Residuals from least Square Being Generated by Gaussian Random Walk", *Econometrica* 51, 153-174.

## Bibliography of Chapter 4

Akram, Q.F., 2006. 'PPP in the medium run: The Case of Norway', *Journal of Macroeconomics* 28, 700-716.

Allington, N.F.B., Kattuman, P.A. and F.A. Waldmann (2005), "One Market, One Money, One Price?", *International Journal of Central Banking* 1(3), 73-115.

Balassa, B. (1961), "Towards a theory of economic integration", *Kyklos* 14, 1-17.

Barnes, S., Lawson, J. and A. Radziwill (2010), "Current account imbalances in the euro area: a comparative perspective", OECD Economics Department Working Paper n°826.

Breuer J.B. (1994), "An Assesment of the Evidence on Purchasing Power Parity", in J. Williamson (eds.), *Estimating Equilibrium Exchange Rates*, Washington D.C.: Institute for International Economics.

Camarero, M. and C. Tamarit (1996), "Cointegration and the PPP and UIP Hypothesis: An Application to the Spanish Integration in the EC", *Open Economics Review* 7, 61-76.

Carlin, W. (2011), "Heterogeneity in the Euro-Zone and Why it Matters for the Future of the Currency Union", in M. Beblavy, D. Cobham and L. Odor (eds.), *The Euro Area and the Financial Crisis*. Cambridge: Cambridge University Press.

Cassel G. (1922), *Money and Foreign Exchange afeter 1914*, London: Constable.

Chinn, M. and E. Prasad (2003), "Medium Term Determinants of Current Accounts in Industrial and Developing Countries: An Empirical Exploration", *Journal of International Economics*, 59, 47-76.

Cline, W.R. (2005), *The United States as a Debtor Nation*, Washington DC: Institute for International Economics and Center for Global Development.

Cline, W.R. (2009), "Long term Fiscal Imbalances, US External Liabilities and Future Living Standards", in F. Bergsten (eds.), *The Long Term International Economic Position of the United States*, Washington DC: Peterson Institute for International Economics.

Dickey, D.A. and W.A. Fuller (1979), "Distribution of the Estimators for Autoregressive Time Series with a Unit Root" *Journal of the American Statistical Association*, 74, 427-431.

Fleming, M. (1971), "On exchange rate unification", *Economic Journal* 81, 467-488.

Gonzalo, J. (1994), "Five Alternative Methods of Estimating Long-run Equilibrium Relationships", *Journal of Econometrics*, 60, 203-233.

Guerreiro, D., Joëts J. and Mignon, V. (2012), "Is price dynamics homogeneous across Eurozone countries", *Journal of Economic Integration, Forthcomming.*

Guerreiro, D. and Mignon, V. (2011), "On price convergence in Eurozone", Working Paper

EconomiX, 2011-34.

Hall, S. and A. Milne (1994), "The Relevance of P-star Analysis to UK Monetary Policy", *The Economic Journal*, 104, 597-604.

Jaumotte, S. and P. Sodsriwiboon (2010), "Current Account Ibalances in the Southern Euro Area", IMF Working-Paper WP/10/139.

Johansen, S. and K. Juselius (1992), "Testing Structural Hypothesis in a Multivariate Cointegration Analysis of the PPP and the UIP", *Journal of Econometrics* 53, 211-244.

Juselius, K. (1991), "Long-run Relations in a well Defined Statistical Model for the Data Generating Process: Cointegration Analysis of the PPP and UIP Relations between Denmark and Germany", in J. Gruber (eds.), *Econometric Decision Models: New Methods of Modeling and Applications*, New York: Springer Verlag.

Juselius, K. (1995), "Do purchasing power parity and uncovered interest rate parity hold in the long run? An example of likelihood inference in a multivariate time-series model", *Journal of Econometrics* 69, 211-240.

Juselius, K. (2003), "Wage, price, and unemployment dynamics in the convergence to PPP in the Euro Area", Discussion Paper n°03-01, Institute of Economics, University of Copenhagen.

Juselius, K. and R. MacDonald (2004), "International parity relationships between Germany and the United States", Finance Research Unit Working Paper, 2004/08 .

Kenen, P. (1969), "The theory of optimum currency areas: an eclectic view", in R.Mundell and A. Swoboda (eds.), *Monetary Problems in the International Economy* Chicago, University of Chicago Press.

Krugman, P. (1979), "A Model of Balance of Payment Crisis", *Journal of Money Credit and Banking*, 11, 311-325.

Lee, J. and M. Strazicich (2003), "Minimum LM Unit Root Tests with Two Structural Breaks", *The Review of Economics and Statistics* 85, 1082-1089.

MacDonald, R. and I.W. Marsh (1997), "On Fundamentals and Exchange Rates: A Casselian Perspective", *Review of Economics and Statistics*, 78, 655-664.

MacDonald, R. and I.W. Marsh (2004), "Currency Spillovers and Tri-polarity: a Simultaneous Model of the US dollar, German mark, and Japanese yen" *Journal of International Money and Finance*, 23, 99-111.

McKinnon, R. (1963), "Optimum currency areas", *American Economic Review* 53, 657-665.

Mundell, R.A. (1961), "A theory of optimum currency areas", *American Economic Review* 51, 715-725.

Ng, S. and P. Perron (2001), "Lag Length Selection and the Construction of Unit Root Tests with Good Size and Power", *Econometrica* 69, 1519-1554.

OECD (1999), *EMU: Facts, Challenges and Policies*, Paris: OECD.

Phillips P.C.B. and P. Perron (1988), "Testing for a Unit Root in a Time Series Regression", *Biometrika*, 75, 335-346.

# Bibliography of Chapter 5

Abdih, Y. and C. Tsangarides (2010), "FEER for the CFA franc", *Applied Economics* 42, 2009-2029.

Alesina, A. and R. J. Barro (2002), "Currency Unions", *The Quarterly Journal of Economics* 117, 409-436.

Banerjee, A. (1999), "Panel Data Unit Root Tests: An Overview", *Oxford Bulletin of Economics and Statistics*, 607-629.

Bangaké, C. (2008), "Exchange Rate Volatility and Optimum Currency Area: Evidence from Africa", *Economics Bulletin* 6, 1-10.

Banque de France (2002), "La Zone Franc", Note d'information n°127.

Basher, S. and J. Westerlund (2009), "Panel cointegration and the monetary exchange rate model", *Economic Modelling* 26, 503-516.

Bayoumi, T. and B. Eichengreen (1997), "Ever close to Heaven? An optimum currency area Index for European Countries", *European Economic Review* 41, 761-770.

Bénassy-Quéré, A. and M. Coupet (2005), "On the Adequacy of Monetary Arrangements in Sub-Saharan Africa", *The World Economy* 28, 349-373.

Broda, C. (2004), "Terms of trade and exchange rate regimes in developing countries", *Journal of International Economics* 63, 31–58.

Carrion-I-Silvestre, L., Bel Barrio-Castro, T. and E. Lòpez-Baso (2005), "Breaking the Panels: An Application to the GDP per Capita", *The Econometrics Journal* 8, 159-175.

Cashin, P., Cespedes, L.F. and R. Sahay (2004), "Commodity Currencies and the Real Exchange Rate", *Journal of Development Economics* 75, 239-268.

Cheung, Y-W. and K. S. Lai (2008), "Nominal exchange rate flexibility and real exchange rate adjustment: New evidence from dual exchange rates in developing countries", *Japan and the World Economy* 20, 415–434.

Coleman, S. (2008), "Estimating Equilibrium Real Exchange Rates in the Franc Zone", *Journal of African Economies* 17, 600-634.

Coleman, S. (2011), "Inflation persistence in the Franc zone: Evidence from disaggregated prices", *Journal of Macroeconomics* 32, 426–442

Coudert, V., Couharde, C. and V. Mignon (2011), "Does Euro or Dollar Pegging Impact the Real Exchange Rate? The Case of Oil and Commodity Currencies", *The World Economy* 34, 1557-1592.

Coudert, V., Couharde, C. and V. Mignon (2012), "On currency misalignments within the euro area", CEPII Working Paper 2012-07, Paris: Centre d'Etudes Prospectives et d'Informations Internationales.

Couharde, C., Coulibaly, I. and O. Damette (2011), "Misalignments and Dynamics of Real Exchange Rates in the CFA Franc Zone", EconomiX Working Paper 2011-28.

De Grauwe, P. (1996), "The economics of convergence: Towards monetary union in Europe", *Weltwirtschaftliches Archiv* 132(1), 1-27.

De Grauwe, P. (2000), *Economics of Monetary Union*, Fourth edition, Oxford University Press.

De Grauwe, P. (2011), "The governance of a fragile eurozone", Mimeo, University of Leuven.

Devarajan, S. and J. de Melo (1990), "Membership in the CFA zone. Odyssean Journey or Trojan Horse?", PPR Working Paper 482, Washington D.C.: World Bank.

Devarajan, S. and D. Rodrik (1991), "Do Benefits of Fixed Exchange Rates outweigh their Costs? The Franc Zone in Africa", NBER Working Paper n°3727, Cambridge, MA: National Bureau of Economic Research.

Dufrénot, G. and K. Sugimoto (2009), "Pegging the future West African single currency in regard to internal/external competitiveness: a counterfactual analysis", William Davidson Institute Working Paper n°974, University of Michigan.

Edwards, S. (1989), "Exchange Rate Misalignments in Developing Economies", *World Bank Research Observer* 4, The World Bank.

Elbadawi, I. and N. Majd (1996), "Adjustment and economic performance under a fixed exchange rate: A comparative analysis of the CFA zone", *World Development* 24, 939–951.

Fielding, D. and K. Shields (2001), "Modelling Macroeconomic Shocks in the CFA Franc Zone", *Journal of Development Economics* 66, 199-223.

Friedman, M. (1953), *Essays in Positive Economics*, Chicago: University of Chicago Press.

Goodhart, C. (1995), "The Political Economy of Monetary Union," in Peter B. Kenen (ed.), *Understanding Interdependence: The Macroeconomics of the Open Economy*, Princeton: Princeton University Press, 450–505.

Hajimichael, M.T. and M. Galy (1997), "The CFA Franc Zone and the EMU", IMF Working Paper WP/97/156, Washington, D.C.: International Monetary Fund.

Hurlin, C. and V. Mignon (2007), "Second Generation Panel Unit Root Tests", Working Paper HALSHS-00159842, HAL.

Kenen, P. (1969), "The Theory of Optimum Currency Areas: An eclectic View", in R. Mundell and A. Swoboda (eds.), *Monetary Problems in the International Economy*, Chicago: University of Chicago Press.

Lane, P. R. and G. M. Milesi-Ferretti (2007), "The external wealth of nations mark II: Revised and extended estimates of foreign assets and liabilities, 1970–2004", *Journal of International Economics* 73, 223-250.

Liu, J., Wu, S. and J.V. Zidek (1997), "On Segmented Multivariate Regression", *Statistica Sinica* 7, 497-525.

Marseille, J. (1984), *Empire colonial et capitalisme français, histoire d'un divorce,* Paris : Albin Michel.

Masson, P. and C. Pattillo (2004), *The monetary geography of Africa*, Washington, D.C.: Brookings Institution.

McKinnon, R. (1963), "Optimum Currency Areas", *American Economic Review* 53, 657-665.

Pesaran, M.H. (2004), "General diagnostic Tests for Cross-section Dependence in Panels", CESifo Working Paper 1233, 255-260.

Pesaran, M.H., Shin, Y. and R. Smith (1999), "Pooled mean group estimation of dynamic heterogeneous Panels", *Journal of the American Statistical Association* 94, 621-634.

Qureshi, M. S. and C. Tsangarides (2012), "Hard or Soft Pegs? Choice of Exchange Rate Regime and Trade in Africa", *World Development* 40(4), 667-680.

Rogoff, K. (1996), "The purchasing power parity puzzle", *Journal of Economic Literature* 34, 647–668.

Soto, R. and I. Elbadawi (2008), "Theory and Empirics of Real Exchange Rates in Developing Countries", Documentos de Trabajo 324, Instituto de Economia, Pontificia Universidad Católica de Chile.

Tavlas, G.S. (1994), "The Theory of Monetary Integration", *Open Economies Review* 5, 211-230.

Tsangarides, C., Ewenczyk, P., Hulej, M. and M.S. Qureshi, (2009), "Are Africa's currency unions good for trade?", *IMF Staff Papers* 56, 876–918.

Westerlund, J. (2005), "New simple Tests for Panel Cointegration", *Econometrics Review* 24, 297-316.

Willett, T. D. (2001), "The OCA Approach to Exchange Rate Regimes: A Perspective on Recent Developments", Working Paper, Claremont Institute of Economic Policy Studies, Claremont, CA.

Yehoue, E (2006), "The CFA Arrangements: More than Just an Aid Substitute", *Economie Internationale* 107, 107-133.

Zhao, X. and Y. Kim (2009), "Is the CFA Franc Zone an Optimum Currency Area?", *World Development* 37, 1877-1886.