

# FLASH ECONOMICS

## ECONOMIC RESEARCH

March 22, 2013 – No. 227

## How large is the infrastructure multiplier in the euro area?

*While austerity measures have failed to bring the expected sustainable consolidation in public finances, the challenge for policymakers is becoming more and more to promote growth as an objective to ease debt to GDP ratios. But with budget constraints being extremely tight, priority has to be given to public spending with the highest multiplier effects. In this flash, we focus on euro area government infrastructure investment, i.e. capital formation in the transport sector:*

- *Estimating a VAR model for the four largest euro area economies, we find that an increase in public infrastructure investment is associated with higher output, private investment and employment in the quarters following the expenditure shock. Moreover the positive effect lasts twice as long in less developed economies as in mature economies. This suggests that infrastructure investment not only drives positive demand shock but also raises factor productivity.*
- *We find that output elasticities with respect to transportation infrastructure investments are very large (0.18 after 5 years). In addition, as higher output implies higher tax revenues over time, infrastructure investment is likely to pay for itself.*
- *At last, estimating the multiplier for different economic regimes, we find that infrastructure investment has a higher impact on activity in economic bad times than in economic normal times (four times larger in the case of France).*

*All these findings suggest that infrastructure investment is highly recommendable as policy lever to augment GDP and reduce the public debt burden, in the current context more than ever.*

### ECONOMIC RESEARCH

Authors:  
Sylvain Broyer  
Johannes Gareis

### ECONOMIC RESEARCH

## VAR model and data

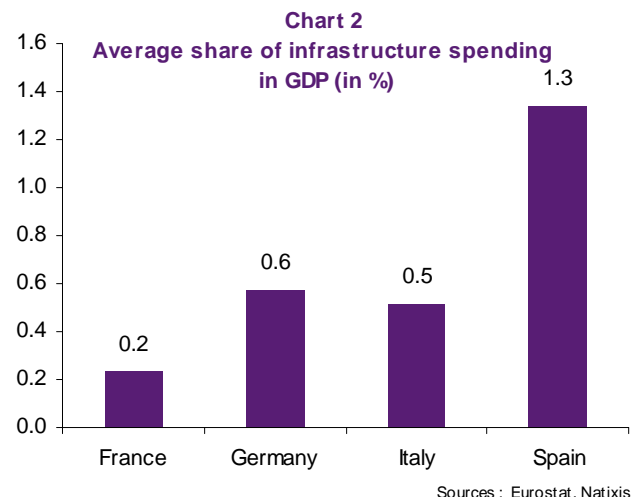
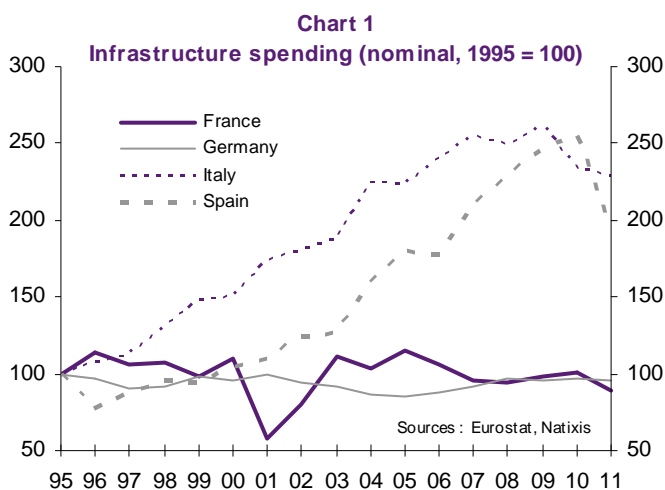
We consider the four largest countries in the euro area: **France, Germany, Italy and Spain**. For each country, we estimate a **4-variable VAR model**, comprising output ( $y_t$ ), employment ( $e_t$ ), private investment ( $i_t$ ) and public infrastructure spending ( $z_t$ ):

$$X_t = A_0 + A_1 X_{t-1} + \dots + A_p X_{t-p} + \varepsilon_t,$$

with  $X_t = [z_t, e_t, i_t, y_t]'$ .

All series are obtained from Eurostat's national accounts database. The sample period runs from **1995:Q4 to 2011:Q4**.

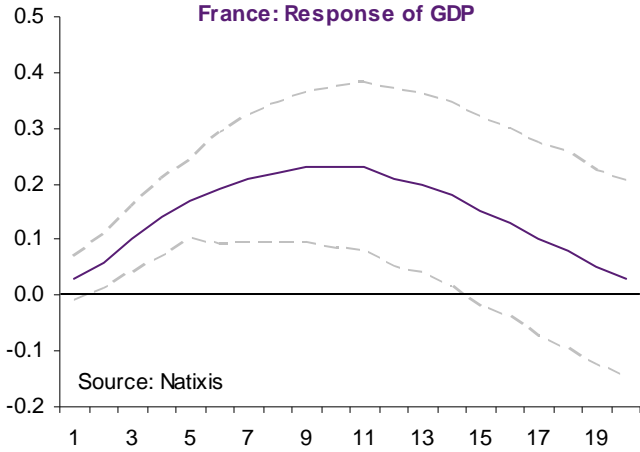
We measure public infrastructure investment as **government gross capital formation (GCF) in the transport sector (Chart 1 and Chart 2)**. Private investment is measured as total gross fixed capital formation (GFCF) minus government GCF. As government GCF is only provided in annual terms, we use linear interpolation techniques to formulate it on a quarterly basis. All variables, except employment, are expressed in real, per capita terms based on the GDP deflator. Finally we take logs of all variables times 100. We include a time trend ( $T_t$ ) and a dummy variable ( $D_t$ ), which is centered around 2008:Q4, as exogenous variables to the model. The estimated VAR is of order one.



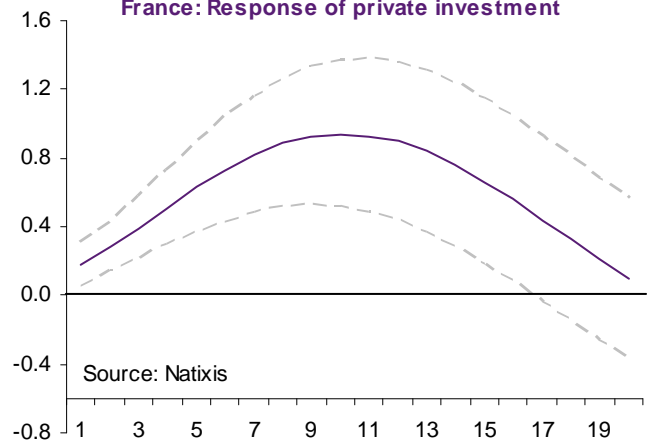
## Impulse responses to public infrastructure investment

In **charts 3a to 6c**, we show the dynamic properties of each VAR model using **impulse response functions (IRFs), measuring the percentage deviation of each variable under consideration from its long-run equilibrium**. In particular, we focus on the dynamic responses of output, private investment, employment and public infrastructure investment to an exogenous, one-time spending shock to infrastructure investment of a size of one standard deviation. In order to identify public spending shocks, we apply a Choleski decomposition as is common in the literature. We apply the following ordering of variables:  $z_t, e_t, i_t, y_t$ . The charts below show the mean IRFs (solid lines) as well as the one standard error bands (dashed-lines). The x-axis is in quarters.

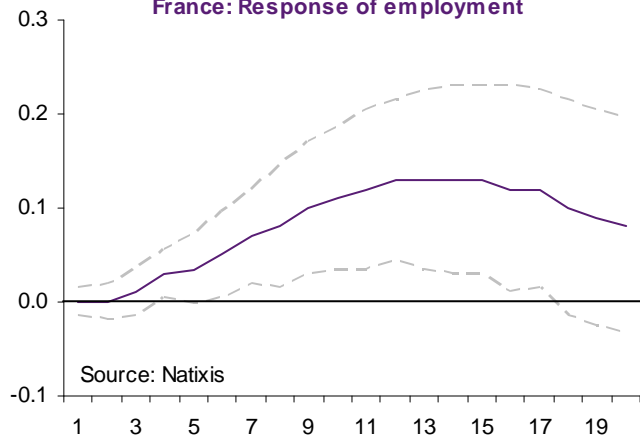
**Chart 3a**  
France: Response of GDP



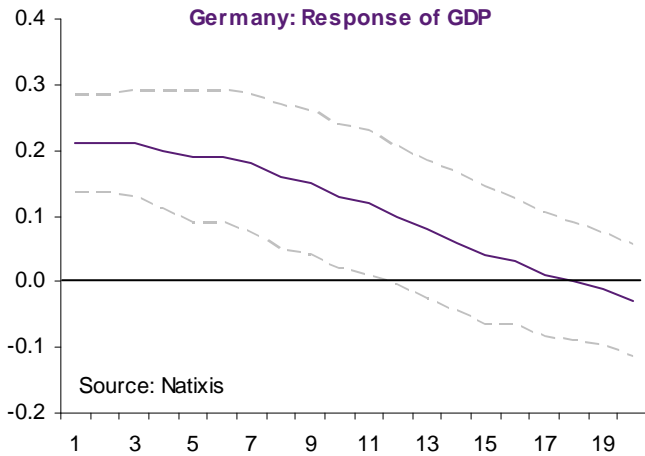
**Chart 3b**  
France: Response of private investment



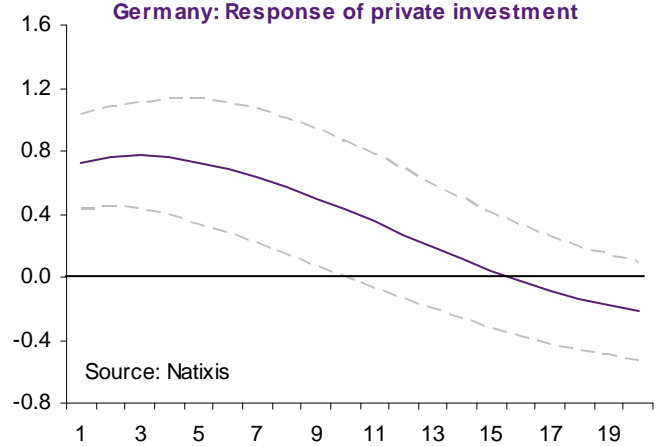
**Chart 3c**  
France: Response of employment



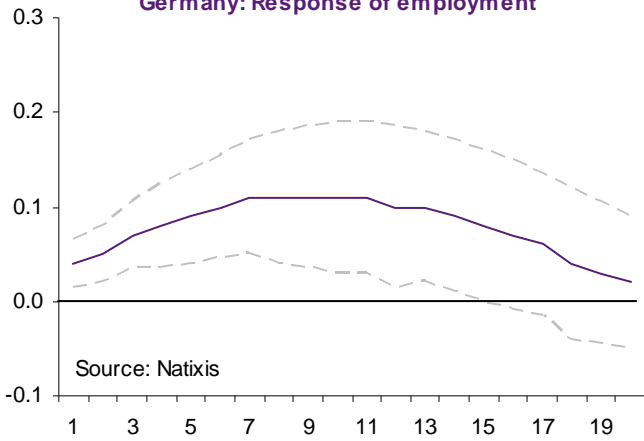
**Chart 4a**  
Germany: Response of GDP



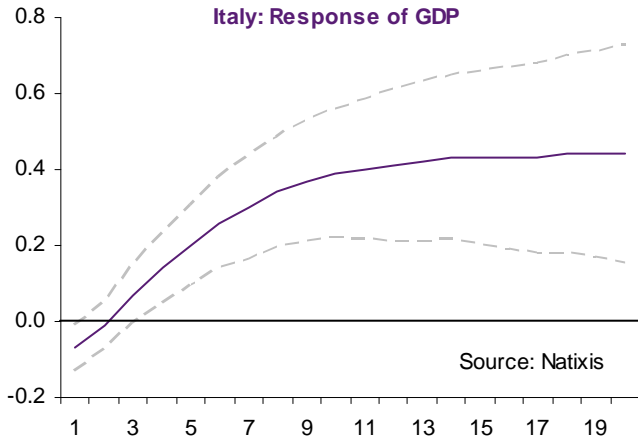
**Chart 4b**  
Germany: Response of private investment



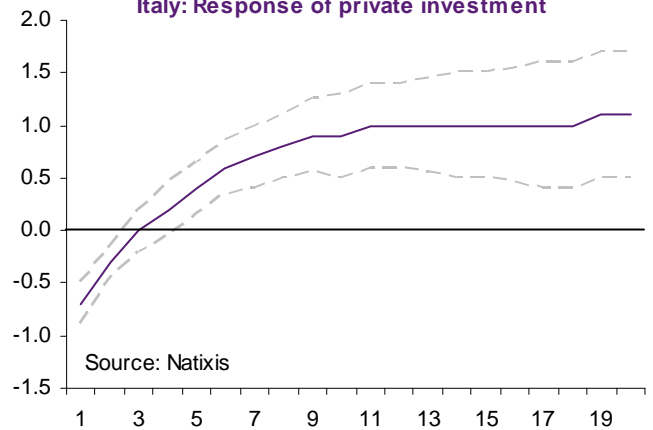
**Chart 4c**  
**Germany: Response of employment**



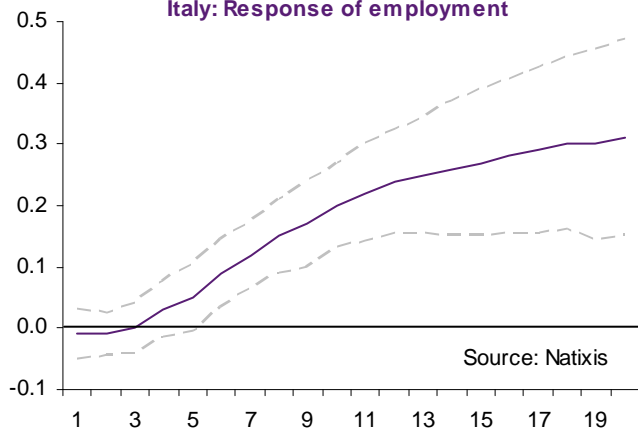
**Chart 5a**  
**Italy: Response of GDP**

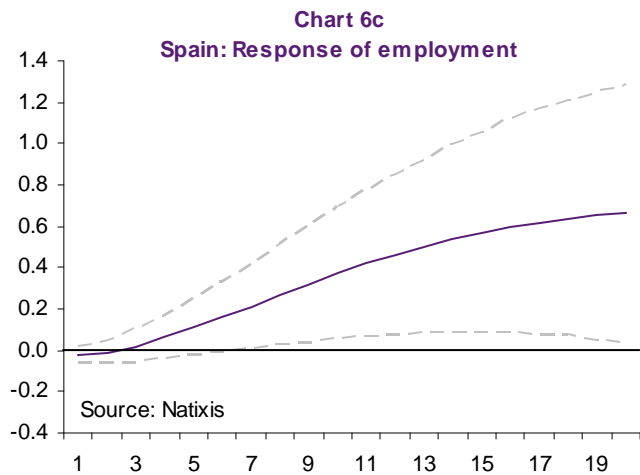
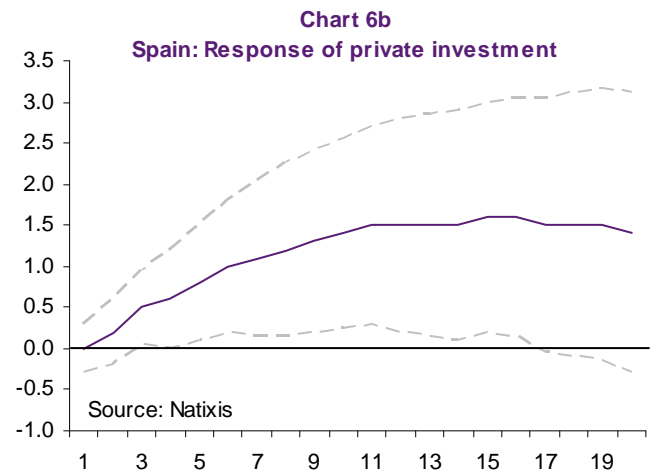
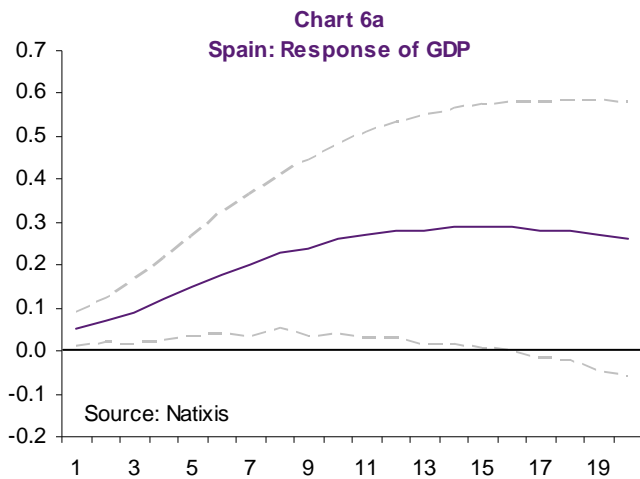


**Chart 5b**  
**Italy: Response of private investment**



**Chart 5c**  
**Italy: Response of employment**





As is apparent from the charts, **for all countries we find that an increase in public infrastructure investment is associated with an increase in output, private investment and employment in the quarters following the expenditure shock.**

Comparing the dynamic responses across countries, it reveals that for Germany and France the effects of public infrastructure investment on output, private investment and employment are relatively short-lived (5 years), while for Italy and Spain the effects are more long lasting. In addition, it is noteworthy that for all countries except Germany, we observe that the peak response of aggregates occurs some quarters after the spending shock hits the economy, which indicates that for those countries the medium-run effects of public infrastructure investment (e.g. increase in productivity capacity) dominate the short-run effects of an increase in demand. For Italy and Spain we find a very substantial impact of government spending on the broader economy, with quantitatively important effects on output lasting up to 50 quarters.

### Output elasticities with respect to infrastructure investment

While the impulse response analysis highlights the qualitative impact of public infrastructure investment, we now focus on **quantitative effects, namely, the output elasticity of public infrastructure investment, which measures the total percentage change of GDP with respect to a one-percentage change in public infrastructure investment.**

In **table 1**, we display the results given by our VAR by taking different time-horizons into account. Each elasticity is computed by dividing the accumulated percentage change in output in response to the government spending shock by the accumulated percentage in public infrastructure. For the EMU-4, we compute the weighted average of the country-specific elasticities.

**Table 1: Output elasticity of infrastructure investment**

<i>Horizon</i>	<b>1 year</b>	<b>2 years</b>	<b>5 years</b>	<b>Long-run</b>
<b>France</b>	0.02	0.04	0.11	0.14
<b>Germany</b>	0.28	0.29	0.22	0.20
<b>Italy</b>	0.02	0.10	0.20	0.22
<b>Spain</b>	0.04	0.08	0.17	0.09
<b>EMU-4</b>	<b>0.11</b>	<b>0.15</b>	<b>0.18</b>	<b>0.17</b>

Source: Natixis

We find large output elasticities for the individual countries under consideration, ranging from 0.09 to 0.22 in the long-run and from 0.02 to 0.28 in the short-run. For the EMU-4, we find an output elasticity with respect to government infrastructure investment of 0.17 in the long-run and of 0.11 in the short-run.

Overall, we can conclude that our estimates are in-line with other studies focusing on government infrastructure spending, though a detailed comparison is difficult given the large amount of different estimation techniques, data and definitions of the government spending variable. For instance, two studies closely related to our analysis are Pereira (2000) and Pereira and Andraz (2007).<sup>1</sup> While the former finds an output elasticity with respect to public core infrastructure investment (like electric and gas facilities) of 0.02 for the US, the latter reports an impact of transportation infrastructures on output of about 0.15 for Portugal.

### Infrastructure multiplier in the euro area

Even though, output elasticities are an indicative concept of demonstrating the effect of public infrastructure investment, what matters for policymakers is the **infrastructure multiplier, which gives the change in euros in output per a change in euros in public infrastructure investment.**

Here, we focus on the impact multiplier in the euro area. We obtain the multiplier by multiplying the average euro area-wide change in output in response to the public infrastructure spending shock normalized to 1% with the average ratio of GDP to public infrastructure investment in the euro area. Doing so, **we obtain an infrastructure multiplier of 14. That is, 1 euro invested in transportation infrastructures in the EMU-4 raises the GDP level on impact by 14 euros.**

All in all, we conclude that infrastructure investment has very large positive effects on the economic performance of euro area countries. Also, as higher output implies higher tax revenues over time, our finding of a very large infrastructure multiplier for the euro area suggests that infrastructure investment is likely to pay for itself.

<sup>1</sup> See Pereira, A.M. (2000), „Is all public capital created equal?“ Review of Economics and Statistics, 82(3), 513-518, and Pereira, A.M. and J.M. Andraz (2007), „Public investment in transportation infrastructures and industry performance in Portugal“, College of William and Mary, Working Paper # 45, Williamsburg.

### Infrastructure spending in good and bad times

To test, whether infrastructure spending has an additional impact during recessionary periods, we use a single equation approach. That is, for each country we take the last equation of the VAR above and include a second dummy variable ( $D_t$ ) into the equation:

$$y_t = a_0 + a_1 D_{09} + a_2 T_t + a_3 y_{t-1} + a_4 i_{t-1} + a_5 e_{t-1} + a_6 z_{t-1} + a_7 z_{t-1} D_t,$$

where  $D_t$  is 1, if the economy is running below its long-term capacity utilisation rate and zero otherwise. **Table 2** displays the results.

**Table 2: Output elasticities with respect to infrastructure spending**

	Coefficient t-Statistic		Coefficient t-Statistic	
	$a_6$		$a_7$	
France	0.01***	2.16	0.03**	2.18
Germany	0.0122	0.57	0.0004	1.02
Italy	0.0359**	2.04	-0.0003	-0.83
Spain	0.0097	1.00	0.0002	0.90

\*\*\* indicates significance at 1% level

\*\* indicates significance at 5% level

Source: Natixis

We find that for all countries, except Italy, the coefficient associated with infrastructure investment in recessionary periods ( $a_7$ ) is positive, which indicates that compared to normal times ( $a_6$ ) infrastructure investments has an additional impact on the broader economy when the economy is depressed. As we find significant results only for France, one has to be careful from drawing a general conclusion from this exercise. In this case, however, we can report that the direct effect of infrastructure investment on output should be on impact approximately four times larger in bad economic time than in general.

**Conclusions:**  
Infrastructure investment is recommended to augment GDP and reduce the public debt burden

While austerity measures have failed to bring the expected sustainable consolidation in public finances, the challenge for policymakers is becoming more and more to promote growth as an objective to ease debt to GDP ratios. But with budget constraints being extremely tight, priorities have to be given to public spending with the highest multiplier effects. In this flash, we focus on euro area government infrastructure investment, i.e. capital formation in the transport sector:

- Estimating a VAR model for the four largest euro area economies, we find that an increase in public infrastructure investment is associated with higher output, private investment and employment in the quarters following the expenditure shock. Moreover the positive effect lasts twice as long in less developed economies as in highly mature economies. This suggests that infrastructure investment not only drive a positive demand shock but also raises factor productivity.
- We find that infrastructure multipliers are very large: 1 euro invested in transport infrastructure in the EMU-4 raises GDP level by 14. In addition, as higher output implies higher tax revenues over time, large infrastructure multipliers suggest that such investment is likely to pay for itself.
- At last, estimating the multiplier for different economic regimes, we find that infrastructure investment has a higher impact on activity in economic bad times than in economic normal times (four times larger in the case of France).



## AVERTISSEMENT / DISCLAIMER

Ce document et toutes les pièces jointes sont strictement confidentiels et établis à l'attention exclusive de ses destinataires. Ils ne sauraient être transmis à quiconque sans l'accord préalable écrit de Natixis. Si vous recevez ce document et/ou toute pièce jointe par erreur, merci de le(s) détruire et de le signaler immédiatement à l'expéditeur.

**Ce document a été préparé par nos économistes. Il ne constitue pas un rapport de recherche indépendant et n'a pas été élaboré conformément aux dispositions légales arrêtées pour promouvoir l'indépendance de la recherche en investissement. En conséquence, sa diffusion n'est soumise à aucune interdiction prohibant l'exécution de transactions avant sa publication.**

La distribution, possession ou la remise de ce document dans ou à partir de certaines juridictions peut être limitée ou interdite par la loi. Il est demandé aux personnes recevant ce document de s'informer sur l'existence de telles limitations ou interdictions et de s'y conformer. Ni Natixis, ni ses affiliés, directeurs, administrateurs, employés, agents ou conseils, ni toute autre personne acceptée d'être responsable à l'encontre de toute personne du fait de la distribution, possession ou remise de ce document dans ou à partir de toute juridiction.

Ce document et toutes les pièces jointes sont communiqués à chaque destinataire à titre d'information uniquement et ne constituent pas une recommandation personnalisée d'investissement. Ils sont destinés à être diffusés indifféremment à chaque destinataire et les produits ou services visés ne prennent en compte aucun objectif d'investissement, situation financière ou besoin spécifique à un destinataire en particulier. Ce document et toutes les pièces jointes ne constituent pas une offre, ni une sollicitation d'achat, de vente ou de souscription. Ce document ne peut en aucune circonstance être considéré comme une confirmation officielle d'une transaction adressée à une personne ou une entité et aucune garantie ne peut être donnée sur le fait que cette transaction sera conclue sur la base des termes et conditions qui figurent dans ce document ou sur la base d'autres conditions. Ce document et toutes les pièces jointes sont fondés sur des informations publiques et ne peuvent en aucune circonstance être utilisés ou considérés comme un engagement de Natixis, tout engagement devant notamment être soumis à une procédure d'approbation de Natixis conformément aux règles internes qui lui sont applicables.

Natixis n'a ni vérifié ni conduit une analyse indépendante des informations figurant dans ce document. Par conséquent, Natixis ne fait aucune déclaration ou garantie ni ne prend aucun engagement envers les lecteurs de ce document, de quelque manière que ce soit (expresse ou implicite) au titre de la pertinence, de l'exactitude ou de l'exhaustivité des informations qui y figurent ou de la pertinence des hypothèses auxquelles elle fait référence. En effet, les informations figurant dans ce document ne tiennent pas compte des règles comptables ou fiscales particulières qui s'appliqueraient aux contreparties, clients ou clients potentiels de Natixis. Natixis ne saurait donc être tenu responsable des éventuelles différences de valorisation entre ses propres données et celles de tiers, ces différences pouvant notamment résulter de considérations sur l'application de règles comptables, fiscales ou relatives à des modèles de valorisation. De plus, les avis, opinions et toute autre information figurant dans ce document sont indicatifs et peuvent être modifiés ou retirés par Natixis à tout moment sans préavis.

Les informations sur les prix ou marges sont indicatives et sont susceptibles d'évolution à tout moment et sans préavis, notamment en fonction des conditions de marché. Les performances passées et les simulations de performances passées ne sont pas un indicateur fiable et ne préjugent donc pas des performances futures. Les informations contenues dans ce document peuvent inclure des résultats d'analyses issues d'un modèle quantitatif qui représentent des événements futurs potentiels, qui pourront ou non se réaliser, et elles ne constituent pas une analyse complète de tous les faits substantiels qui déterminent un produit. Natixis se réserve le droit de modifier ou de retirer ces informations à tout moment sans préavis. Plus généralement, Natixis, ses sociétés mères, ses filiales, ses actionnaires de référence ainsi que leurs directeurs, administrateurs, associés, agents, représentants, salariés ou conseils respectifs rejettent toute responsabilité à l'égard des lecteurs de ce document ou de leurs conseils concernant les caractéristiques de ces informations. Les opinions, avis ou prévisions figurant dans ce document reflètent, sauf indication contraire, celles de son ou ses auteur(s) et ne reflètent pas les opinions de toute autre personne ou de Natixis.

Les informations figurant dans ce document n'ont pas vocation à faire l'objet d'une mise à jour après la date apposée en première page. Par ailleurs, la remise de ce document n'entraîne en aucune manière une obligation implicite de quiconque de mise à jour des informations qui y figurent.

Natixis ne saurait être tenu responsable des pertes financières ou d'une quelconque décision prise sur le fondement des informations figurant dans la présentation et n'assume aucune prestation de conseil, notamment en matière de services d'investissement. En tout état de cause, il vous appartient de recueillir les avis internes et externes que vous estimez nécessaires ou souhaitables, y compris de la part de juristes, fiscalistes, comptables, conseillers financiers, ou tous autres spécialistes, pour vérifier notamment l'adéquation de la transaction qui vous est présentée avec vos objectifs et vos contraintes et pour procéder à une évaluation indépendante de la transaction afin d'en apprécier les mérites et les facteurs de risques.

Natixis est agréée par l'Autorité de contrôle prudentiel (ACP) en France en qualité de Banque – prestataire de services d'investissements et soumise à sa supervision. Natixis est réglementée par l'AMF (Autorité des Marchés Financiers) pour l'exercice des services d'investissements pour lesquels elle est agréée.

Natixis est agréée par l'ACP en France et soumise à l'autorité limitée du Financial Services Authority au Royaume Uni. Les détails concernant la supervision de nos activités par le Financial Services Authority sont disponibles sur demande.

Natixis est agréée par l'ACP et régulée par la BaFin (Bundesanstalt für Finanzdienstleistungsaufsicht) pour l'exercice en libre établissement de ses activités en Allemagne. Le transfert / distribution de ce document en Allemagne est fait(e) sous la responsabilité de NATIXIS Zweigniederlassung Deutschland.

Natixis est agréée par l'ACP et régulée par la Banque d'Espagne (Bank of Spain) et la CNMV pour l'exercice en libre établissement de ses activités en Espagne.

Natixis est agréée par l'ACP et régulée par la Banque d'Italie et la CONSOB (Commissione Nazionale per le Società e la Borsa) pour l'exercice en libre établissement de ses activités en Italie.

Natixis ne destine la diffusion aux Etats-Unis de cette publication qu'aux « major U.S. institutional investors », définis comme tels selon la **Rule 15(a)(6)**. Cette publication a été élaborée et vérifiée par les économistes de Natixis (Paris). Ces économistes n'ont pas fait l'objet d'un enregistrement professionnel en tant qu'économiste auprès du NYSE et/ou du NASD et ne sont donc pas soumis aux règles édictées par la FINRA.

This document (including any attachments thereto) is confidential and intended solely for the use of the addressee(s). It should not be transmitted to any person(s) other than the original addressee(s) without the prior written consent of Natixis. If you receive this document in error, please delete or destroy it and notify the sender immediately.

**This document has been prepared by our economists. It does not constitute an independent investment research and has not been prepared in accordance with the legal requirements designed to promote the independence of investment research. Accordingly there are no prohibitions on dealing ahead of its dissemination.**

The distribution, possession or delivery of this document in, to or from certain jurisdictions may be restricted or prohibited by law. Recipients of this document are therefore required to ensure that they are aware of, and comply with, such restrictions or prohibitions. Neither Natixis, nor any of its affiliates, directors, employees, agents or advisers nor any other person accept any liability to anyone in relation to the distribution, possession or delivery of this document in, to or from any jurisdiction.

This document (including any attachments thereto) are communicated to each recipient for information purposes only and do not constitute a personalised recommendation. It is intended for general distribution and the products or services described therein do not take into account any specific investment objective, financial situation or particular need of any recipient. It should not be construed as an offer or solicitation with respect to the purchase, sale or subscription of any interest or security or as an undertaking by Natixis to complete a transaction subject to the terms and conditions described in this document or any other terms and conditions. Any undertaking or commitment shall be subject to Natixis prior approval and formal written confirmation in accordance with its current internal procedures. This document and any attachments thereto are based on public information.

Natixis has neither verified nor independently analysed the information contained in this document. Accordingly, no representation, warranty or undertaking, express or implied, is made to the recipients of this document as to or in relation to the accuracy or completeness or otherwise of this document or as to the reasonableness of any assumption contained in this document. The information contained in this document does not take into account specific tax rules or accounting methods applicable to counterparties, clients or potential clients of Natixis. Therefore, Natixis shall not be liable for differences, if any, between its own valuations and those valuations provided by third parties; as such differences may arise as a result of the application and implementation of alternative accounting methods, tax rules or valuation models. In addition, any view, opinion or other information provided herein is indicative only and subject to change or withdrawal by Natixis at any time without notice.

Prices and margins are indicative only and are subject to changes at any time without notice depending on inter alia market conditions. Past performances and simulations of past performances are not a reliable indicator and therefore do not predict future results. The information contained in this document may include the results of analysis derived from a quantitative model, which represent potential future events, that may or may not be realised, and is not a complete analysis of every material fact representing any product. The information may be amended or withdrawn by Natixis at any time without notice. More generally, no responsibility is accepted by Natixis, nor any of its holding companies, subsidiaries, associated undertakings or controlling persons, nor any of their respective directors, officers, partners, employees, agents, representatives or advisors as to or in relation to the characteristics of this information. The opinions, views and forecasts expressed in this document (including any attachments thereto) reflect the personal views of the author(s) and do not reflect the views of any other person or Natixis unless otherwise mentioned.

It should not be assumed that the information contained in this document will have been updated subsequent to date stated on the first page of this document. In addition, the delivery of this document does not imply in any way an obligation on anyone to update such information at any time.

Natixis shall not be liable for any financial loss or any decision taken on the basis of the information contained in this document and Natixis does not hold itself out as providing any advice, particularly in relation to investment services. In any event, you should request for any internal and/or external advice that you consider necessary or desirable to obtain, including from any financial, legal, tax or accounting advisor, or any other specialist advice, in order to verify in particular that the investment(s) described in this document meets your investment objectives and constraints and to obtain an independent valuation of such investment(s), its risks factors and rewards.

Natixis is authorised in France by the *Autorité de contrôle prudentiel* (ACP) as a Bank – Investment Services providers and subject to its supervision. Natixis is regulated by the AMF in respect of its investment services activities.

Natixis is authorised by the ACP in France and subject to limited regulation by the Financial Services Authority in the United Kingdom. Details on the extent of our regulation by the Financial Services Authority are available from us on request.

Natixis is authorised by the ACP and regulated by the BaFin (Bundesanstalt für Finanzdienstleistungsaufsicht) for the conduct of its business in Germany. The transfer / distribution of this document in Germany is done by / under the responsibility of NATIXIS Zweigniederlassung Deutschland.

Natixis is authorised by the ACP and regulated by Bank of Spain and the CNMV for the conduct of its business in Spain.

Natixis is authorised by the ACP and regulated by Bank of Italy and the CONSOB (Commissione Nazionale per le Società e la Borsa) for the conduct of its business in Italy.

This research report is solely available for distribution in the United States to major U.S. institutional investors as defined by **SEC Rule 15(a)(6)**. This research report has been prepared and reviewed by research economists employed by Natixis (Paris). These economists are not registered or qualified as research economists with the NYSE and/or the NASD, and are not subject to the rules of the FINRA.