NATIXIS

FLASH ECONOMICS

ECONOMIC RESEARCH

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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 theses 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

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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):

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

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.

Chart 1
Infrastructure spending (nominal, 1995 = 100)

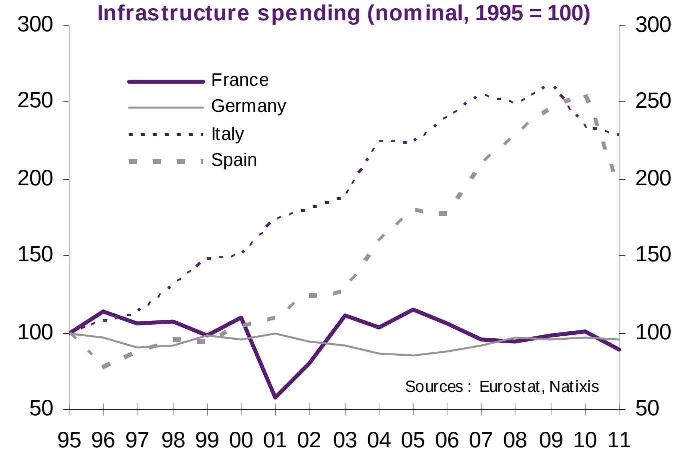
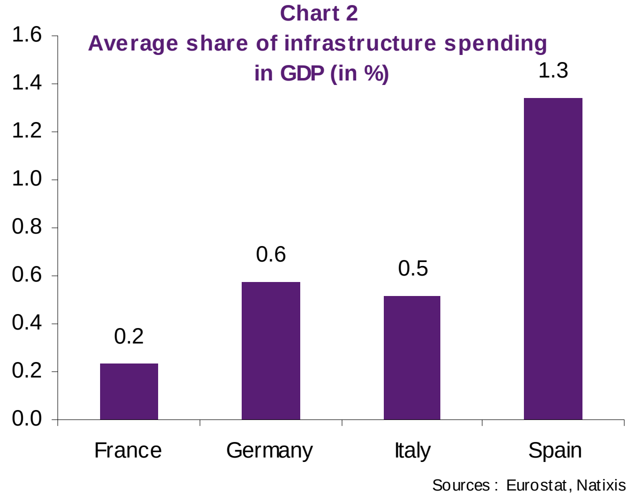


Chart 2
Average share of infrastructure spending in GDP (in %)



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.

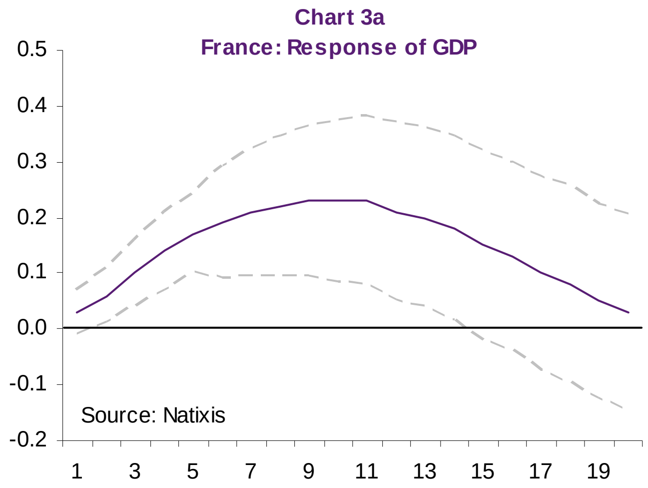


Chart 3a
France: Response of GDP
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
Source: Natixis
1 3 5 7 9 11 13 15 17 19

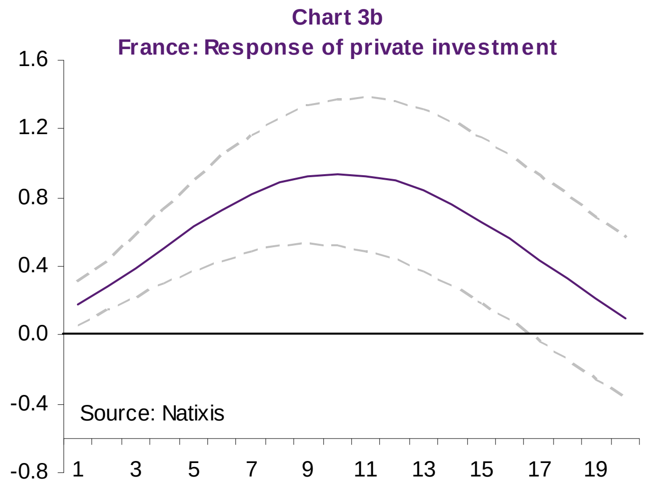


Chart 3b
France: Response of private investment
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
Source: Natixis
1 3 5 7 9 11 13 15 17 19

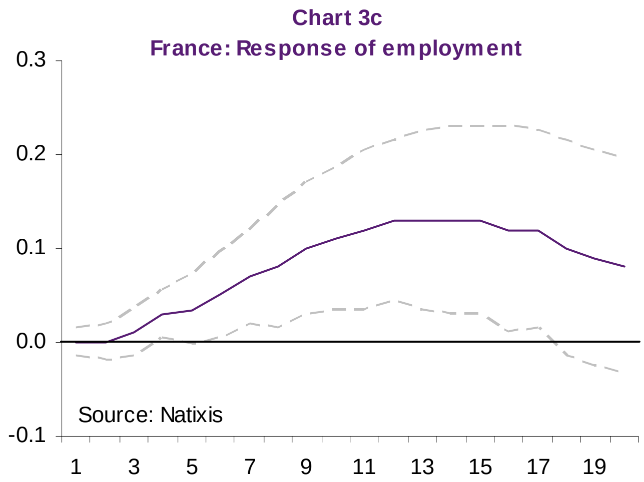


Chart 3c
France: Response of employment
0.3
0.2
0.1
0.0
-0.1
Source: Natixis
1 3 5 7 9 11 13 15 17 19

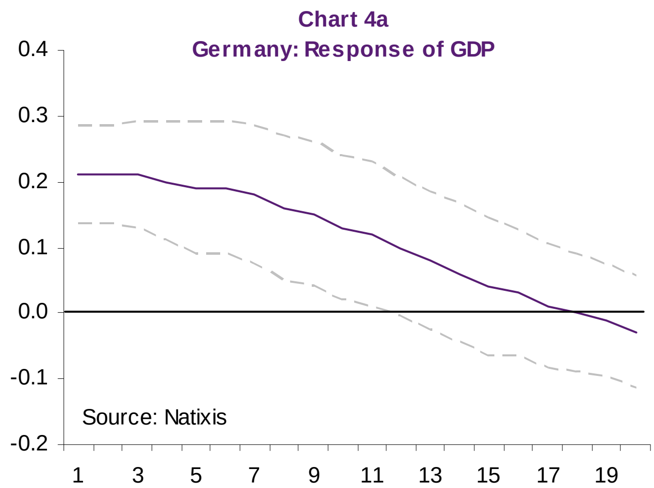


Chart 4a
Germany: Response of GDP
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
Source: Natixis
1 3 5 7 9 11 13 15 17 19

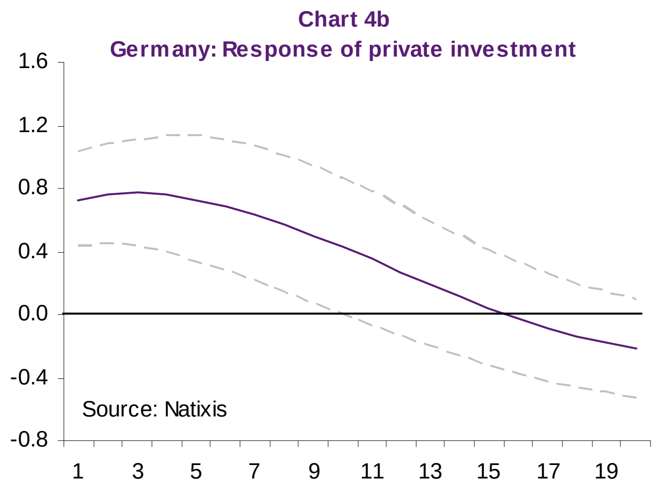


Chart 4b
Germany: Response of private investment
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
Source: Natixis
1 3 5 7 9 11 13 15 17 19

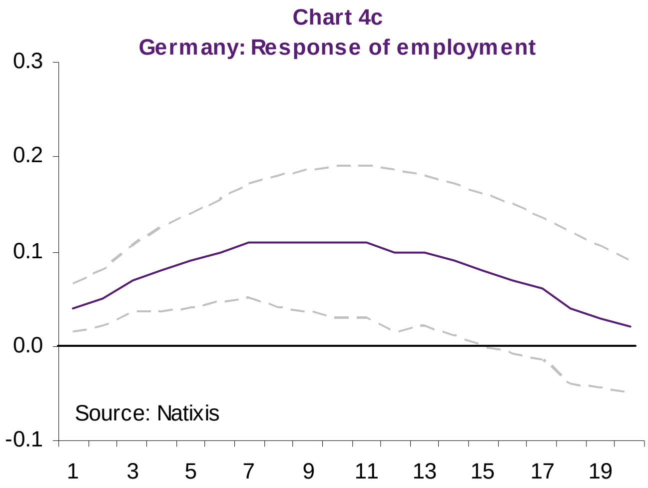


Chart 4c
Germany: Response of employment
0.3
0.2
0.1
0.0
-0.1
Source: Natixis
1 3 5 7 9 11 13 15 17 19

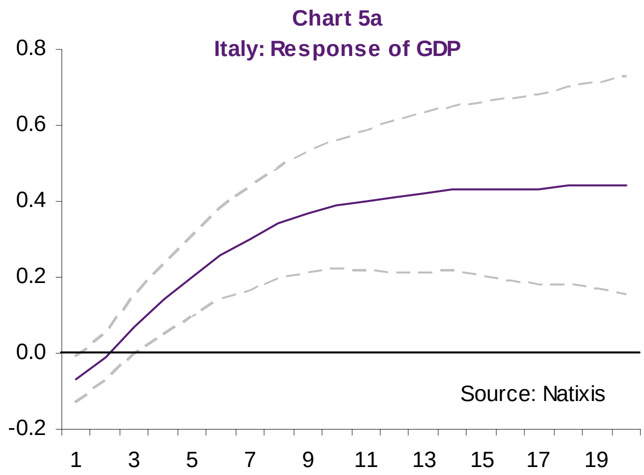


Chart 5a
Italy: Response of GDP
0.8
0.6
0.4
0.2
0.0
-0.2
Source: Natixis
1 3 5 7 9 11 13 15 17 19

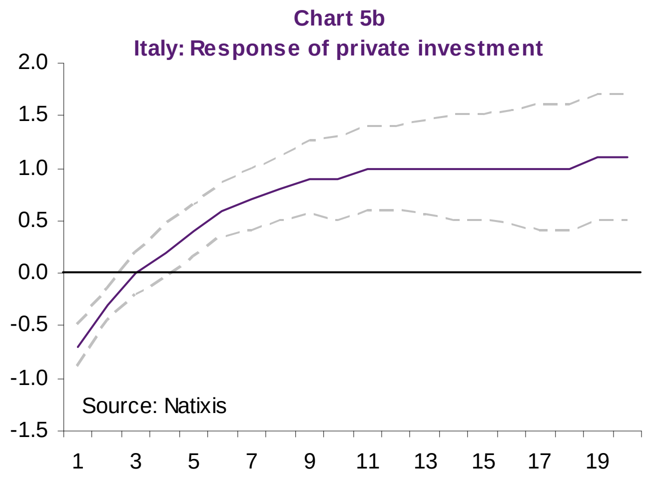


Chart 5b
Italy: Response of private investment
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
Source: Natixis
1 3 5 7 9 11 13 15 17 19

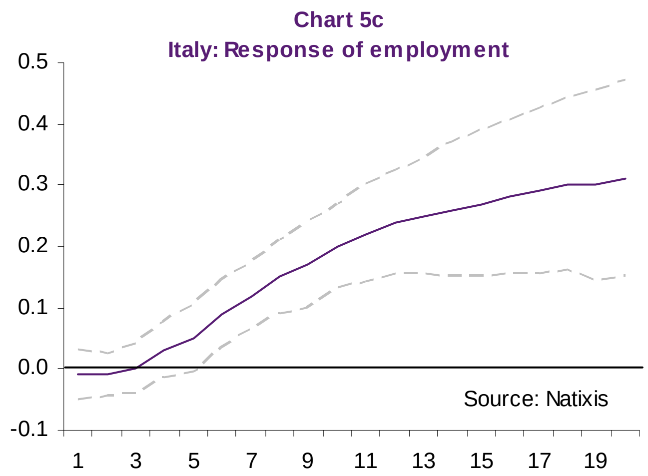
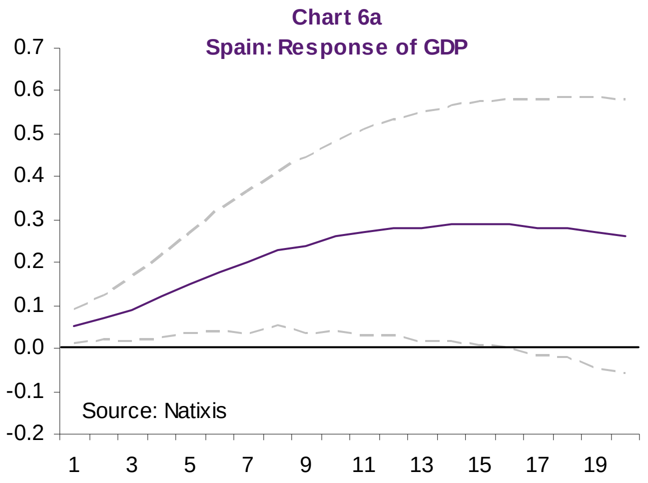
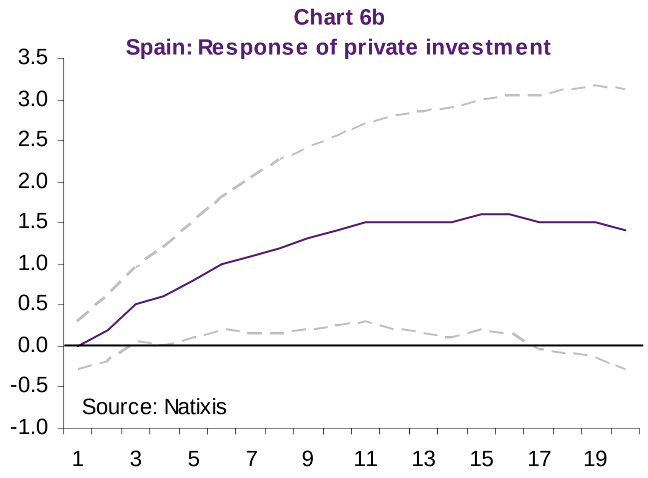
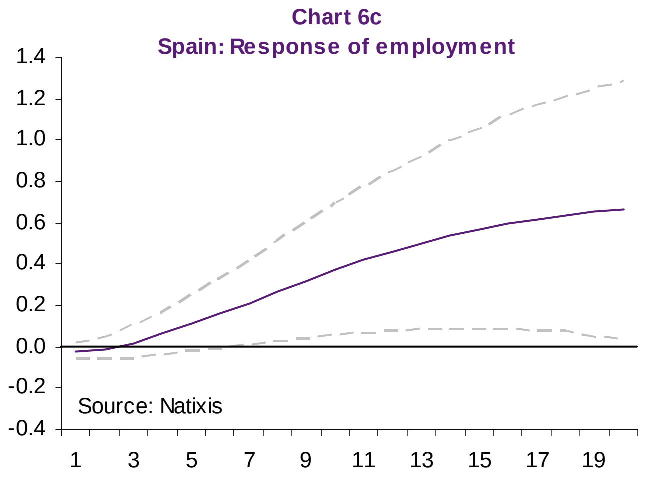


Chart 5c
Italy: Response of employment
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
Source: Natixis
1 3 5 7 9 11 13 15 17 19







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 infrastrucutre 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 infrastrucutre investment

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

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).[1] 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 are 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.

[1] 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 recommendable 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).**

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