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Algerian pipeline gas pricing in the Italian and Spanish markets: Structural changes in oil and European gas price pass-through, 2009-2025

تسعير الغاز الجزائري عبر الأنابيب في الأسواق الإيطالية و الإسبانية: التغيرات الهيكلية في أسعار النفط ونقل أسعار الغاز الأوروبية، 2009-2025

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Abstract :

This paper analyzes oil and European gas price pass-through to Algerian pipeline-gas border prices in Italy and Spain over the 2009-2025. We use monthly Eurostat trade data and ARDL-ECM models with structural-break tests to assess long-run elasticities, adjustment dynamics and destination heterogeneity. Both Brent and European gas prices remain relevant for both, but their relative importance and transmission differ across markets.

The strongest evidence of structural instability is concentrated in the second half of 2022, although results are more sensitive to the specification for Spain. Overall, the results suggest a destination-specific reconfiguration of pass-through rather than an outright exit from oil-linked pricing.

Key words: Algeria, pipeline gas, oil prices, European gas markets, structural change.
JEL classification codes: Q41, C22, F14, L95

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1. Introduction

Algeria plays an important role as a supplier of pipeline gas to Southern Europe, especially to Italy and Spain. However, the transmission of international energy-price shocks to the border prices of Algerian gas is relatively underexplored, especially when distinguishing between the two destination markets.

Historically, the price of Algerian gas has been closely linked to oil-indexed long-term contracts. De Bock and Gijón (2011) demonstrated that despite the liberalization of European gas markets, Algerian gas prices remained strongly correlated with crude oil. But the pricing landscape in Europe has changed quite a lot since then. The emergence of liquid gas hubs and the increasing use of hub-based references have reduced the dominance of traditional oil indexation in continental Europe (Miriello and Polo, 2015). However, recent evidence suggests that this transition is not being viewed as a complete separation between oil and gas prices. Their relation may turn weaker, nonlinear or regime shifting, but still economically important (Hasanli, 2024; SzafranekandRubaszek, 2024).
The European energy crisis of 2021-2022 offers an unusually informative setting to study such changes.
During this period, European gas prices rose much more sharply than crude-oil prices. This divergence is important because when oil and gas benchmarks move together, it is hard to separate out their influence on import prices that are observed. Thus the crisis created a backdrop where changes in benchmark sensitivity and speed of adjustment became visible.

The Algerian case is even more pertinent, since Italy and Spain did not adapt in the same way. Algerian pipeline gas to Italy averaged around €79,5/MWhin the third quarter of 2022 according to the World Bank (2023), while the Spanish price was close to €43/MWh. Thus the Italian price increased much more sharply during the peak of the crisis and the bilateral pipeline volumes behaved differently in the two destinations. Such divergence is difficult to capture with a single aggregate Algerian export-price series and suggests that adjustment may matter to destination as well as to common international benchmarks.

This paper thus asks: what has been the pass-through of oil and European gas prices to Algerian pipeline-gas border prices and is this transmission different between Italy and Spain? The question is deliberately wider than whether Algerian gas 'decoupled' from oil. Instead, a change in pass-through might show up in the form of different long-run elasticities, shorter or loner adjustment lags, or a changing relative role of Brent and European gas prices.

This analysis is based on monthly observations from January 2009 to December 2025. Destination-specific border unit values are calculated from Eurostat bilateral trade values and additional quantities for Algerian gaseous-natural-gas imports into Italy and Spain. These series are analyzed jointly with Brent crude-oil prices and a European natural gas benchmarks.

The unit value are interpretated as average border prices rather than as a direct measure of individual contracts because the underlying contractual formulas are not publicly observed. The Empirical strategy employs ARDL-ECM models and structural-break tests that do not impose 2022 as an exogenous break point. This allows to separate persistent long-run relationships from changes in the timing and composition of price transmission. Bilateral heterogeneity is not hidden by aggregation, since Italy and Spain are estimated separately.

This paper contributes to the literature in two related ways. First, it is based on previous work on the historical oil linkage of Algerian gas, investigating whether this linkage remained during the recent transformation of European gas markets. Second, it implies that the relevant adjustment is destination-specific: the Italian and Spanish border-price relationships do not evolve in the same way. In this way, the paper views Algerian pricing of gas as an evolving pass-through mechanism than a binary choice between oil indexation and hub pricing.

2. Literature review

The natural-gas pricing literature has gradually moved from a crude question of whether gas prices are tied to oil. Earlier studies generally reported a persistent relationship between the two markets. Panagiotidis and Rutledge (2007) using UK data, found a long run

equilibrium relationship between Brent crude oil and wholesale gas prices despite market liberalization. Asche and al. (2013) arrived at a similar conclusion for continental Europe, demonstrating strong integration between spot gas prices, contact prices and oil.
These results were consistent with a market where oil-indexed pricing and long-term contracts still played a significant role. Subsequent research demonstrated that this relationship is not necessarily stable over time. Brigida (2014) showed that the apparent oil-gas decoupling may be due to a temporary regie change and not to a permanent breakdown of the long-run relationship. Structural changes in gas-market conditions can affect the strength and persistence of oil-gas linkages, as shown by Coporin and Fontini (2017). There's recent evidence to support this view.

Using tie-varying regime-switching models, Hasanli (2024) finds that oil sensitivity has weakened over time, but the long-run relationship has not disappeared. Szafranek and Rubaszek (2024) further show that gas-specific shocks have become more important in Europe, whereas oil shocks still explain a share of gas-price dynamics at longer horizons. Taken together, these studies indicate that the empirical question is not whether oil "matters" or "does not matter", but whether its role shifts in relation to other gas-market forces.

This change is closely linked to the development of European gas hubs. Miriello and Polo (2015) describe the emergence of hub-based trading as a gradual evolution, rather a rapid substitution of long-term contracts. As liquidity deepened, hub prices increasingly served as reference points for procurement and price discovery. Hulshof and al. (2016) find in their study of the Dutch TTF that gas-specific fundamentals such as storage and weather have become more important than oil prices in explaining short-run hub-price movements. Wider evidence on European integration points in the same direction: gas markets became more connected but national and contractual differences did not disappear (Broadstock and al., 2020).

These developments were exacerbated by the energy crisis of 2021-2022. Szafranek and al. (2023) show that the European gas-market connectedness was disrupted but not eliminated after Russia's invasion of Ukraine, while continental hubs remained strongly connected. This matters for this study because imported pipeline gas

is priced in a market environment that is increasingly being shaped by European gas benchmarks, even when bilateral long-term contracts are still in place.

Much less attention has been paid to Algeria in this pricing literature. The most directly relevant contribution is De Bock and Gijón (2011) who show that Algerian gas prices remained closely linked to oil prices during the 2000s, although the strength of the relationship had started to weaken. Their work provides a key historical benchmark and implies that the re-establishment of a Brent-Algerian gas relationship would have limited novelty.

More recent work on Algeria has been largely focused on supply security, infrastructure and the country's strategic role in replacing some of Europe's lost Russian gas. For example, Tahchi (2024) is concerned with Algeria's role in European energy security and emphasizes the importance of Italy and Spain, but does not give estimates of bilateral price transmission or structural changes in benchmark sensitivity.

This creates a more specific empirical gap. On one hand, the literature has established that oil-gas relationships can change across regimes. In contrast, it has established that European gas prices have become more strongly shaped by hub-based market conditions. For Algeria, however, much less is known about whether these changes are reflected in border prices of pipeline gas, especially when Italy and Spain are treated separately.

The destination dimension matters because the bilateral adjustment does not have to be simultaneous.

Differences in contractual revision schedules, commercial arrangements or adjustment lags may mean that a common international shock is transmitted differently across markets. The aggregation of Italian and Spanish observations into one Algerian export-price series may therefore obscure exactly the kind of structural variation the paper is interested in.

This study is situated at this intersection, it does not test for a binary switch from oil indexation to hub pricing. Rather, it asks whether the size and timing of pass-through from Brent and European gas prices changed over time and whether those changes were different in Algeria's two main Southern European pipeline markets.

This approach ties the historical evidence on Algerian oil-linked pricing to the more recent literature on European gas-market transformation and regime instability.

3. Data and Methodology

The empirical analysis employs monthly data from January 2009 to December 2025. For Italy and Spain, we separately construct Algerian pipeline-gas border unit values using Eurostat COMEXT bilateral trade data for natural gas in gaseous state (CN 27112100). The import values in euros for each destination are divided by the correspondent supplementary quantity in terajoules and converted into Euro per megawatt hour, by month:

$$P_{j,t} = \frac{V_{j,t}}{Q_{j,t} \times 277{,}7778}$$

Where $V_{j,t}$ is monthly import value and $Q_{j,t}$ the reported quantity in TJ. (1 TJ=*277,7778 MWh*). The series that are obtained are interpreted as average border unit values, not as direct observations of individual contract prices.

We employ two external energy indicators. Brent crude oil data and European natural-gas prices which are extracted from the IMF/FRED database. The latter is throughout this paper referred to the European gas benchmark, as the source does not name the whole historical series as a pure TTF quotation. International standards are quoted in euro, using the monthly EUR/USD exchange rate. All price variables are entered into the econometrics in natural logs.

Table 1: Variables and sources

Variable	*Definition*	*Source*	*Unit*
$\boldsymbol{P_{IT}}$	Algerian pipeline-gas border unit value, Italy	Eurostat COMEXT	€/MWh
$\boldsymbol{P_{ES}}$	Algerian pipeline-gas border unit value, Spain	Eurostat COMEXT	€/MWh
Brent	European crude-oil benchmark	IMF/FRED	€/barrel
GasEU	European natural-gas benchmark	IMF/FRED	€/MWh
$\boldsymbol{Q_{IT}, Q_{ET}}$	Bilateral pipeline-gas quantities	Eurostat COMEXT	TJ

Source: Author's compilation based on Eurostat COMEXT and World Bank Commodity Price Data (WBCPD)

Our empirical strategy has three components. First, the integration properties of the logarithmic prices series are tested by using standards unit-root and stationarity tests. As none of the core

variables is found to be I(2), the ARDL framework is used to estimate destinationspecific both short and long-run price relationships. This is the base equation:

$$p_{j,t} = \alpha_j + \sum_{i=1}^{p} \emptyset_{j,i} P_{j,t-i} + \sum_{k=0}^{q_B} \beta_{j,k}\, b_{t-k} + \sum_{m=0}^{q_G} \gamma_{j,m}\, g_{t-m} + \varepsilon_{j,t}$$

Where $p_{j,t}$ is the log border unit value, b_t the log Brent price, and g_t the log European gas benchmark. Using an information criterion, lag orders are chosen separately for Italy and Spain.

Second, we use the ARDL bounds-testing approach of Pesaran and al. (2001) to examine the existence of long-run relationship. The model is written in error correction form where supported to enable the recovery of long-run elasticities and speed of adjustment.

Third, we analyze structural instability without assuming 2022 as an a priori break point. The Gregory-Hansen regime-shift tests are employed to detect an endogenous change in the cointegrating relationship, and then long-run elasticities and short-run dynamics are compared across regimes. This allows the analysis to differentiate between changes in benchmark sensitivity and changes in the timing of adjustments.

Separate estimates are provided for Italy and Spain. This is important because the paper is not concerned with an aggregate Algerian export-price relationship, but rather with destination market heterogeneity.

One final data caveat is worth mentioning. From 2022, Eurostat notes that partner attribution for pipeline gas may be based on an estimate. Hence, we take a conservative approach to interpreting any structural change around the crisis period and check it against alternative specifications rather than automatically ascribing it to contractual repricing.

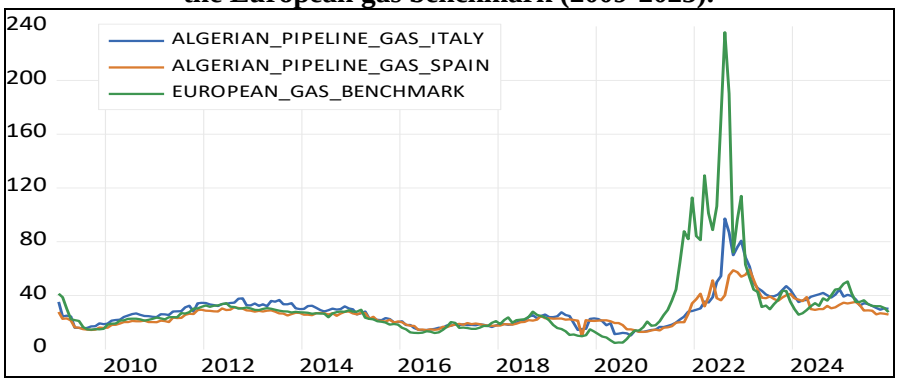
4. Results

4.1. Baseline relationships and description patterns

The Algerian pipeline-gas border prices to Italy and Spain are fairly close for much of the pre-crisis period but diverge sharply in the European energy crisis. Average unit value is €23,49/MWh in Italy and €21,50/MWh in Spain over 2009-21.The gap increases significantly in 2022. The Italian series reaches €97,11/MWh in august while the Spanish price is around €40/MWh in the same

month, peaking only later, in February 2023. The Italy-Spain spread therefore gets both wider and much more volatile.

Figure 1: Algerian pipeline-gas border prices in Italy and Spain and the European gas benchmark (2009-2025).



Source : Author's compilation based on Eurostat COMEXT and WBCPD. Border prices are calculated from bilateral import values and quantities, the European benchmark is the Netherlands Title Transfer Facility (TTF) natural gas price.

But the timing is particularly striking. Brent peaks earlier, but the European gas benchmark also reaches its sample maximum in August 2022.While this coincidence does not reveal the underlying contractual mechanism, it does demonstrates why the crisis offers an informative setting in which to examine changes in price transmission.

The bilateral series are monthly Eurostat observations on Algerian gaseous-natural-gas trade. International benchmarks cover the same 2009-2025 period. The common sample also includes Brent and the European gas benchmark, available on a monthly basis.

Standard unit-root and stationarity tests indicates that the logarithmic prices series are I(1)and no evidence of I(2) is found for any of the series.

The specification selected for the null of no long-run relationship in both cases, with F-Stat of 22,58 for Italy and 26,55 for Spain.

Table 2: Baseline ARDL-ECM results

	Italy	*Spain*
Selected ARDL	(1,4,1)	(3,1,1)
Bounds F-Statistic	22,58	26,55
Error-correction coefficient	-0,259***	-0,256***
Brent long-run elasticity	0,811***	0,448***
European gas long-run elasticity	0,382***	0,399***

Source: Author's estimations based on the dataset described in table1.
*Notes: All price variables are in log. HAC inference is used. ***p<0,01.*

The error-correction coefficient are quite similar across destinations: around a quarter of a deviation from the estimated long-run relationship is corrected the following month. But the makeup of the benchmark is different. The long-run Brent elasticity is about twice the elasticity of the European gas benchmark in Italy. In Spain the two coefficients are very close together. This full-sample comparison already suggests that a unique pricing equation would conceal meaningful bilateral differences. However, it does not specify whether those differences were constant over the sample.

4.2. Structural instability

The main evidence on this is provided by the Gregory-Hansen regime-shift tests. When the break date is endogenously determined, the strongest evidence of instability is concentrated in the second half of 2022.

For Italy, the minimum test statistic is associated with a break approximately in August 2022; for Spain, the corresponding date is approximately October 2022. In the baseline BIC specification, the null of non-cointegration is rejected in both markets.

The Italian result is not simply a swap of benchmarks. The increase in long-run elasticity is not statistically significant and Brent is strongly linked to the border price before and after the estimated break. The change in the European gas coefficient is even less.

Table 3: Structural change and long-run elasticities

	Italy	*Spain*
Endogenous break	2022M08	2022M08
Gregory-Hansen ADF*	-6,04	-5,90
Brent, pre-break	0,789***	0,413***
Brent, post-break	0,963***	0,895***

p-value: pre = post	0,247	0,015
European gas, pre-break	0,312***	0,358***
European gas, post-break	0,345***	0,445***
p-value: pre = post	0,766	0,397

Source: Author's estimations based on the dataset described in Table1.
*Notes: Long-run elasticities are obtained from regime-interacted ECM specifications. HAC covariance estimates are used. ***p<0,01. Break dates refer to the estimated regime transition under the baseline specification.*

Spain does things differently. The estimated Brent elasticity rises from about 0,41 before the break to 0,90 after the break and the difference is statistically significant at the 5% level. The European gas elasticity also increases but the change is less and is statistically insignificant. Therefore, the post-2022 regime cannot be characterized as a mere transition from oil to European gas pricing. The oil relationship is large, and in the Spanish specification, becomes larger. The short-run dynamics are changed too. The joint tests reject equality of the dynamic coefficient vectors before and after the break for both destinations (p<0,01). Evidence thus suggests a change not only in the sensitivity of the benchmark but in the timing with which international movements of prices arrive at observed border values.
This distinction is important because a structural change does not necessarily imply a large change in long-run elasticities. Much of the change in Italy in particular seems to be due to a process of dynamic adjustment rather than to the substitution of one benchmark for another.

4.3. What can be inferred from results?

The baseline estimates provide three results.
First, both Brent and European gas prices are relevant to the Algerian pipeline-gas border values over the sample. The data does not support a complete disappearance of the oil relationship.
Secondly, the transmission channel is not the same for every destination. In Italy the full-sample Brent relationship is stronger and Spain is characterized by more substantial regime variation.
Thirdly, the strongest evidence of instability is in the second half of 2022, without specifying this date a priori.

However,these results should be read as evidence of changesobserved price pass-through, not as direct identification of

confidential contract formulas. The break tests establish statistical instability in the pricing relationship, but they do not establish which contractual revision, market event or institutional mechanism caused it.

5. Discussion

The results suggest a reshaping of Algerian pipeline-gas price transmission, not a straightforward substitution of oil indexation by European gas pricing. Brent remains relevant in both destinations markets and the European gas benchmark also plays a role in the long-run relationship. The change observed around the 2022 crisis is thus about the disappearance of one benchmark.

This interpretation is consistent with the broader literature on oil-gas. Already in the 2000s, De Bock and Gijón (2011) showed that Algerian gas prices continued to track oil closely. Such relationships can weaken, be non-linearor regime-dependent without crumbling, as indicated by more recent studies (Hasanli, 2024 ;Szafranek&Rubaszek, 2024). Our results generalize this argument to the case of Algerian bilateral pipeline prices: the exceptional disruption of European gas markets seems to have altered the transmission mechanism but not in the form of a complete oil-gas decoupling.

The Italian case is a particularly clear illustration of this. The border price reacted sharply during the energy crisis, but the estimated long-run elasticities do not vary much across regimes. The changes in structure is more apparent in the short-run dynamics. Hence, an observed large price increase should not be automatically equated with a permanent change in benchmark composition. In a market with long term contracts and periodic price revisions adjustment can be made through the speed and lag structure of transmission while the underlying long run relationship remains broadly intact.
Spain shows a less stable pattern.

The estimated elasticity of Brent increases after the baseline break, but the robustness analysis shows that the Spanish oil relationship is more sensitive to the sample window and lag specification than the Italian one.This casts doubt on any claim of a single, well-identified structural break in Spain. A more defensible interpretation is that Spanish price formation became more variable across regimes and

specifications which in itself points to greater instability in benchmark transmission.

The bilateral comparison is therefore the center of the paper, not a secondary exercise. Italy and Spain are exposed to the same large international energy shocks, but their observed border prices do not respond in the same way. This is consistent with differences in the timescales for contractual revision, commercial arrangements and market circumstances. For example, the World Bank (2023) reports that the Italian purchase price of Algerian gas increased much faster in the third quarter of 2022 than in Spain. The econometric evidence is consistent with heterogeneous adjustment but cannot identify which specific contractual clause caused this difference.

The distinction is important since the dependent variables are border unit values and not confidential contract prices. Thus, the estimated coefficients should be interpreted as reduced-form measures of observed pass-through. They show how international energy prices are embedded in bilateral import values over time, bur do not reveal the precise indexation formula used in any particular Sonatrach contract.

The findings also challenge the traditional story of European gas-market change. The advent of liquid hubs has obviously increased the importance of gas-specific price signals (Miriello and Polo, 2015; Hulshof and al., 2016), but this does not mean that oil-indexed mechanisms have vanished from long-term pipeline trade. The evidence here is more consistent with a hybrid pricing environment where oil and European gas conditions occur together and their relative influence can vary by destination and time.

For Algeria, it is more than a matter of contract pricing. The speed or makeup of pass-through alters the effects of international energy shocks on actual export prices. So, when the divergence between oil and European gas prices is large, hydrocarbon revenues may be affected by destination-specific pricing arrangements before considering any changes in export volumes. This adds some insight into the economic significance of the transmission mechanism itself for a hydrocarbon-exporting economy.
The results should, however, be stated with caution. The evidence for a structural break in the late-2022 is strongest for Italy and more

sensitive to the specification for Spain. The Eurostat partner attribution for pipeline gas also becomes more delicate from 2022 onward. The baseline gas benchmark is also wider than a pure TTF series. These issues do not overturn the main finding that pass-through is heterogenous and time-varying, but they limit the precision with the underlying contractual mechanism can be identified.

To summarize, the evidence supports a narrower conclusion than a simple shift from oil pricing to hub pricing. Algerian pipeline-gas prices remain linked to both international oil and European gas-market conditions, but the transmission of theses signals varies by destination and over time.

6. Robustness tests

The robustness analysis is restricted to specifications that could have material consequences on the interpretation of price pass-through. Four dimensions are considered: the currency denomination, the selection of lags, the bilateral quantities and the sample dependance. Our goal is not to reestimate the baseline under all possible alternative specifications, but to examine the robustness of the main results to plausible changes in specifications.

The quantitative results are the same, expressed in US dollars instead of euros. Brent and the European gas benchmark continue to be positively correlated with Algerian border prices in both destinations. The strongest evidence of structural instability continues to be concentrated in the second half of 2022. Thus, the results are not affected by the EUR/USD conversion.

The choice of lag selection criteria affects the magnitude of the coefficients somewhat, but not the overall pattern. Replacing BIC with AIC lowers the estimated Brent elasticities in each market and increases the relative importance of the European gas benchmark, especially in Italy. But the two benchmark are still relevant. This sensitivity indicates that the magnitude of pass-through should be interpreted with more caution than its sign and statistical significance.

Adding the bilateral pipeline quantities has only a small impact on the benchmark coefficient. This is not to say that quantities are exogenous to prices, but rather that the estimated relationships

between Brent and European gas are not simply a statistical artifact of the large changes in the bilateral flows observed during the crisis. The most important caveat has to to with Spain. When the estimation window is reduced, especially when the sample stats in 2015, the Brent relation is weaker than the Italian equation. The exact timing and significance of the Spanish structural break is also more sensitive to lag-selection choices. The Italian evidence is much stronger across specifications.

Table 4: Robustness cheks

Robustness check	*Italy*	*Spain*	*Main implication*
Prices expressed in USD	Main relationships preserved	Main relationships preserved	Results not driven by currency conversion
AIC instead of BIC	Both benchmarks remain significant	Both benchmarks remain significant	Magnitudes depend partly on lag selection
Pipeline quantities included	Price coefficients virtually unchanged	Price coefficients virtually unchanged	Results not explained by contemporaneous volume changes
Sample starts in 2010	Baseline pattern preserved	Baseline pattern broadly preserved	Limited sensitivity
Sample starts in 2015	Brent remains important	Brent becomes less robust	Spanish benchmark composition is more sample-dependent
Alternative break specifications	Late-2022 instability remains	Break significance more sensitive	Strong break evidence for Italy

Source: Author's estimations based on the dataset described in Table 1.

The robustness exercises thus reinforce one conclusion and modify another. Oil and European gas prices tend to be resilient in their relationships, particularly for Italy. By contrast, Spain's benchmark composition and timing of structural change are less stable.

The paperthus reads the Spanish results as indicating more time variation and specifications sensitivity, rather than evidence of one sharply identified regime shift.

7. Conclusion

This paper has studied the transmission of oil and European gas-price movements to Algerian pipeline-gas border prices in Italy and Spain in the period 2009-2025. The analysis was motivated by a sample question: did the exceptional disruption of European gas markets alter the way international energy prices are reflected in Algerian pipeline-gas prices and did that adjustment differ across destinations?

The result do not point to a clear shift from oil-based pricing to pricing based on the European gas market. Brent continues to be relevant in both the markets and the European gas benchmark also helps explain the long run relationships. The evidence is thus more consistent with reconfiguration of passe-through than with a perfect substitution of one benchmark for another.

The conclusion rests on comparing destinations. While Italy exhibits a relatively strong and robust brent relationship, the Spain is more compelling evidence of structural instability is found in the second half of 2022, but the break is more robustly identified for Italy tan Spain. This asymmetry suggests that a single aggregate mechanism uniformlyapplied to European buyers is not representative of Algerian pipeline-gas pricing. The result also indicate that structural change need not be just large changes in long-run elasticities. Part of the adjustment takes place through short-run dynamics and the timing of international price changes on border values. This is especially true in a bilateral pipeline-dominated environment with long-term contracts where the timing of price-review provisions and adjustment lags may have an influence on observed prices even if traditional benchmark linkages are maintained.

These findings have implications for Algeria's economy. The composition and speed of pass-through may have implications for the realized export price and, ultimately, the transmission of international energy shocks to hydrocarbon revenues when oil and European gas prices diverge. Thus, destination-specific pricing relationships are important not only for gas-market but also for understanding Algeria's external exposure to energy-price volatility.

However, there are still some limitations. Eurostat trade unit values are proxies for average border prices, and attribution of pipeline-gas partner becomes more delicate from 2022 onward. The baseline European gas variable is wider than a pure TTF series and the post-

break sample is still quite short. Thes limits prevent the estimated changes from being attributed to specific contractual mechanisms.
In future work, the sample of post-crisis episodes could be expanded, a historical TTF benchmark defined consistently and more detailed contractual information included where it is publicly available. The main finding for this study is more modest but more defensible: Algerian pipeline-gas price transmission is time-varying and destination-specific, with oil still important though European gas market conditions play a larger role in the pricing environment.

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9. Appendices

Table 1: Baseline ARDL-ECM estimates, endogenous regimes shift and diagnostic tests

	Italy	**Spain**
Ljung-Box Q(12), *p-value*	0,784	0,996
Breusch-Pagan, *p-value*	0,026	0,175
ARCH-LM(12), *p-value*	0,795	<0,001
Jarque-Bera, *p-value*	<0,001	<0,001
CUSUM stability test	No rejection at 5%	Borderline instability
HAC covariance correction	Yes	Yes
Alternative currency denomination	Main results preserved	Main results preserved
AIC instead of BIC	Main results preserved	Coefficient more sensitive
Pipeline quantities added	Main coefficients virtually unchanged	Main coefficient broadly unchanged
Sample starting in 2010	Results preserved	Results preserved
Sample starting in 2015	Brent remains significant	Brent becomes less robust
Alternative break specifications	Late-2022 break remains plausible	Break date/significance more sensitive

Source: Author's estimates