

Working Paper

INTERNATIONAL MONETARY FUND

WP/99/12

INTERNATIONAL MONETARY FUND

IMF Institute

**The Euro and the Production Structure and Export Performance of
Middle East and North African Countries**

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January 1999

Abstract

This paper explores the link between exchange rate volatility of European currencies and economic performance of several countries in the Middle East and North Africa (MENA). The elimination of intra euro-zone exchange rate volatility resulting from the introduction of the euro is estimated to affect the production structure of MENA economies and shift their exports from manufacturing to agriculture and services. At the country and industry levels, the impact of the euro is more striking in countries with higher shares of manufacturing and higher shares of exports to the euro zone.

JEL Classification Numbers: F02, F14, F15, F33, O53

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Keywords: euro, exchange rate, exports, production structure

¹This paper was written while the author was a summer intern at the IMF Institute, Middle Eastern Division. He is grateful to Samir El-Khouri, Suheil Kavar, and Mounir Rached for their support, and would like to thank Dalia Hakura, Samir Jahjah, Mohsin Khan, Abdelhak Senhadji, and seminar participants at the Institute for helpful suggestions. The paper benefited from comments by Professor Ehsan Choudhri of Carleton University. The author would also like to thank Daniel Treffer for data conversion keys. Finally, he is grateful for support from NSF Belgium (Fond National de la Recherche Scientifique). Comments are welcome and can be sent to the author's e-mail address.

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I. INTRODUCTION

It is often asserted that the volatility of European exchange rates affects countries with close economic ties to Europe (see for example, World Economic Outlook, October, 1997, p.73). Middle East and North African (MENA) countries belong to this category, as nearly 40 percent of their exports are destined to the 11 countries in the euro zone.² The currency unification that took place with the introduction of the euro is bound to have a significant impact on Europe's trading partners.

Recent studies on the euro and MENA countries have focused on its growth impact. In particular, Nashashibi, Allum, and Enders (1998) estimated that, at the country level, Egypt, Syria, and Tunisia are expected to be net gainers, while Algeria and Jordan are expected to be net losers, and with gains offsetting losses for Morocco. Other IMF papers have provided similar conclusions. For a good coverage of this body of work, see Kahn and Nord (1998). The studies are comprehensive, covering both the financial and the real aspects for the region.

This paper offers both a narrower focus and a deeper scope than the studies mentioned. The focus is limited to a particular financial-real linkage: the impact of intra euro zone exchange rate volatility on the production structure and export performance of MENA countries. The scope is extended by exploring and estimating sectoral effects using industrial panel data for 11 industries.³ In particular, it is believed that a deeper understanding of the impact of the historical European Monetary System (EMS) episodes on the MENA countries can shed light on the future prospects for the region. The results obtained allow identification of potential gainers and losers at the sectoral and country levels, providing guidance on the likely pitfalls and opportunities associated with the introduction of the euro.

The paper shows that the introduction of the euro will have two effects that can be estimated empirically without the use of arbitrary measures of import and export elasticities. First, the freezing of parities among the currencies of euro participants and the resulting elimination of intra-euro zone exchange rate volatility will reduce transaction costs favoring industries within the euro zone, partly at the expense of MENA industries; this is a diverting or substitution effect (see also Nashashibi, Allum, and Enders, 1998, and Kahn and Nord, 1998). In particular, it is expected that low value-added industries in MENA countries (e.g., basic manufacturing goods) will suffer the most from this effect, leaving the high value-added industries (e.g., crude oil and minerals) largely insulated. Along with this first effect is an income effect, reflecting the lower transaction costs, which in turn will induce an expansion

²The paper's analysis covers the following 16 MENA countries: Algeria, Bahrain, Egypt, I. R. of Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, and United Arab Emirates. The 11 countries of the euro zone are the EU-15 members except Denmark, Greece, Sweden and the United Kingdom.

³Agriculture, minerals, crude oil, food, textile, wood, chemicals, basic, steel, machinery, and services (see detailed industrial composition in Table 1).

and higher income in Europe, thus raising import demand for products from MENA industries. This effect is expected to benefit both high and low value-added industries.

Since the issue pertains to the *net* effects, the relevance of this analysis needs to be placed in a broader perspective of economic development. As with all other developing economies, MENA countries have to undergo greater diversification of production and exports to reduce their dependence on primary products. The identification of the net effect determines whether the monetary unification in Europe helps or hinders diversification in MENA countries by shifting factors of production into or out of emerging manufacturing industries.⁴

The paper is organized as follows. Section II lays down the basic structure of the theoretical model. Section III presents the empirical methodology, describes the industrial panel for MENA countries, and provides the evidence on the financial-real linkage. Section IV investigates the impact on export performance and compares the experience of the region to that of other countries with close economic ties to Europe. Both the estimation of the impact on exports and comparison with other countries are designed to build confidence in the results and ensure that they conform with more reliable trade data and a larger sample of countries. Finally, Section V summarizes the findings and derives some policy implications.

II. THE MODEL

The model focuses primarily on depicting the impact of the euro on the production structure and export performance of MENA countries. This can be achieved in two ways. One approach, using partial relationships, assesses the extent of correlation based on regression techniques. The other, a more ambitious one, holds that the financial-real linkage can be derived as a reduced form model of export under uncertainty. This section identifies the basic structure of the reduced model.⁵

The theoretical framework borrows from the theory of investment under uncertainty (see Dixit, 1989, and Dixit and Pindyck, 1994). It makes the analogy between an investment choice and an exporting choice. Indeed, the decision to export entails a decision to hire additional factors of production to invest. This setup, despite some strong assumptions, is more appropriate for economies with less diversified production structures. More important, it emphasizes that financial instability abroad can have a substantial impact on the domestic real economy.

⁴The intuition is similar to the Dutch disease problem, whereby discovery of natural resources is harmful to the development process because it drives factors of production to the primary sector (see Lewis, 1989).

⁵For a more extensive treatment of this model, see Ruhashyankiko (1998).

The model assumes that intra-euro volatility, σ^{euro} , affects the industry-specific transaction costs, $1 < \tau_i < \infty$, by letting the price inclusive of transaction costs, $R_i \equiv P_i / \tau_i$ follow a random walk in continuous time (i.e., a Brownian motion)

$$\frac{dR_i}{R_i} = \mu dt + \sigma^{euro} dz \quad (1)$$

where dz is the increment of the Wiener process and μ is a trend rate of growth of the price inclusive of transaction costs. This assumes that intra euro zone exchange rate volatility will affect the structure of production through its effect on transaction costs.

The aggregate current GDP, $Y(R, F)$, is the sum of industrial value-added (V_i), which depends on the price inclusive of transaction costs (R_i) and industrial factor endowment (F_i):

$$Y(R, F) \equiv \sum_i V_i(R_i, F_i) \quad (2)$$

Each industry has a fixed initial endowment of factors of production. Production can then be specified by the following equation:

$$V_i(R_i, F_i) = P_i[Z_i + \frac{1}{\tau_i}X_i(F_i)] - C_i = R_i X_i(F_i) + \theta_i \quad (3)$$

$$\theta_i \equiv P_i Z_i - C_i$$

where P_i is the output price, Z_i is the output, C_i is material cost, and X_i is the quantity exported by industry i . $R_i X_i$ is the value of exports. The value of domestic output minus the value of material costs can be assumed as an industry-specific constant.⁶

The opportunity cost of waiting is $R_i / (\rho - \mu)$, where ρ is the discount rate and $(\rho - \mu) > 0$. In a standard fashion, the value of waiting (or value of the option to export) is found by applying Ito's lemma:

$$B_i(R_i, F_i) = H_i R_i^{\eta_i} \quad (4)$$

where H_i and η_i are constants. An optimal decision to export (and hire factors) is made when the cost of waiting exceeds the value of waiting by an amount h_i ; a domestic sunk cost

⁶The sample exhibits a high correlation of 0.72 between exports and value-added.

$$\frac{R_i}{\rho - \mu} - H_i R_i^{\eta_i} > h_i \quad (5)$$

(i.e., industry i exercises the option and pays the strike price h_i if it is valuable to do so), which increases with the industrial value-added share of GDP.⁷

Thus, there is a price inclusive of transaction cost above which it is optimal to become an exporter. Since a decision to export entails a reallocation of factors of production, the current value-added V_i may deviate from its optimal level B_i as follows:

$$V_i = (\rho - \mu)B_i(R_i, F_i) + \frac{E(dB_i)}{dt} \quad (6)$$

where deviations during the time period dt are the result of changes in the price inclusive of transaction costs given by equation 1. Hence, expanding the second term by using equations 1 and 4 yields:⁸

$$\frac{V_i}{B_i} = (\rho - \mu - \eta_i) + \frac{1}{2}\eta_i(\eta_i - 1)(\sigma^{euro})^2 \quad (7)$$

Equation 7 provides a direct way of estimating the impact of intra euro zone exchange rate volatility on the production structure and export performance. Setting the optimal flow of value-added as a constant share of GDP allows substituting Y for B .⁹

$$\frac{V_i}{Y} = \alpha_i + \beta_i(\sigma^{euro})^2 \quad (8)$$

⁷The intuition is that in presence of domestic adjustment costs, factors of production allocated to the high value-added sector are being drawn from the low value-added sector where they have a higher marginal product (see Ruhashyankiko, 1998, for further details).

⁸Details are provided in appendix.

⁹Even though this simplification appears to be strong, the paper argues that appropriate industry-specific fixed effects and random effects introduced in the estimation will actually take care of varying shares in GDP across industries. Moreover, time dummies will also capture the potentially time-varying component of them. Thus, despite the simplification, the approach should not undermine the empirical results.

where V_i/Y is industry i share of value-added in GDP, $\alpha_i \equiv (\rho - \mu - \eta_i)$ is an industry-specific constant term, $\beta_i \equiv 1/2 \eta_i (\eta_i - 1)$ is the coefficient of interest, and the explanatory variable is the intra-euro volatility. The latter is measured by the standard deviation of the month-to-month bilateral exchange rate (between country j and country k in the euro zone for a given year t). Unambiguously, this measure will equal zero as of 1999.¹⁰ This relationship could be used to assess the impact of exchange rate volatility on the production structure in MENA countries. The size and sign of exchange rate impact indicates how industries may be affected by the introduction of the euro.

Equation 8 embodies a simple rule to lead the empirical analysis.¹¹ Given that the introduction of the euro will eliminate the intra-euro volatility:

- In low value-added industries, a net diverting or substitution effect is expected to be reflected in a positive β_i coefficient; these industries will be *net* losers.
- In high value-added industries, a negative β_i coefficient reflects a net creating or income effect; these industries will be *net* gainers.

A priori, the impact on individual countries is ambiguous and depends on the country-specific production structure and export orientation. For the region as a whole, the model holds that the introduction of the euro will benefit high value-added industries, which tend to be natural resource based (e.g., crude oil and minerals or agriculture) at the expense of emerging low value-added industries such as manufacturing, (see Lewis, 1989).

III. EMPIRICAL METHODOLOGY

The empirical analysis uses industrial panel data for the period 1960–97 to capture the impact of intra euro zone exchange rate volatility on the real economy in MENA countries. Given the two cross-sectional dimensions (i.e., industries $i=1, \dots, I$ and countries $j=1, \dots, J$), it is necessary to choose between two approaches to deal with the heterogeneity of the panel. On the one hand, the impact of intra euro zone exchange rate volatility can be treated as homogenous across industries within countries in MENA. On the other hand, the impact of this volatility can be treated as homogenous across countries within industries and then analyzed industry by industry. Given that a specific industry across MENA countries appears to be more homogenous than industries within a given country, the second approach is adopted.

Using subscripts j for country and t for time, equation 8 can be written as follows:

$$y_{ijt} = \alpha_i + v_j + \delta_{it} + \beta_i x_{jt} + \epsilon_{ijt} \quad (9)$$

¹⁰The intra-euro exchange rate volatility will be null since the month-to-month bilateral exchange rate will be completely fixed after January 1, 1999 for the 11 countries of the euro zone.

¹¹ See details in appendix.

where $y_{ijt} \equiv \ln[V_{ijt} / Y_{ijt}]$ and $x_{ijt} \equiv \ln[\omega_{ijt} (\sigma_t^{\text{euro}})^2]$. In addition to the basic equation, the variables were transformed into logarithms, and three required components were introduced: v_j , δ_t , and ω_j .

First, v_j are country-specific effects that capture the high level of heterogeneity that exists across MENA countries. A random-effect generalized least square (GLS) regression will be performed. The country-specific effect is assumed random, $v_j \sim N(v, \sigma_v^2)$, with a fixed variance of equal magnitude across countries.¹² This captures common shocks, beyond intra euro zone volatility, that may affect MENA countries. The random-effect estimators provide cross-country evidence on within-country deviation from the time average. While some sectors (e.g., agriculture) might exhibit relatively important cross-sectional variance in the MENA region, others (e.g., manufacturing) might exhibit a relatively important time-series variance (see Figures 1–7). Hence, the generalization of Ordinary Least squares (OLS) to allow for such random-effect provides a unique methodology to capture these effects: b_i are the industry-specific random-effect estimates from equation 9.

Second, δ_t are time dummies capturing sector-specific time effects (e.g., shares of manufacturing and services in GDP are growing over time), which are common to MENA countries. The empirical model would not be accurate if such time effects were ignored.¹³

Finally, $\omega_{ijt} \equiv X_{ijt}^{\text{euro}} / X_{ijt}^{\text{world}}$ is the ratio of MENA exports to the euro zone to MENA exports to the world. The role of the weighting parameters is to capture the proximity of economic link with the euro zone. Without an economic link, the intra-euro volatility would not be expected to have any impact at all; conversely, the stronger the link, the greater the expected impact. The trade pattern has been chosen as a channel and measure of economic closeness to the euro zone market. Introducing such a weight has the added advantage of being quite practical, as the variable σ_t^{euro} , capturing the intra-euro volatility, varies over time but is identical across industries and countries. The weight allows finding country-specific measures of the impact of the euro, which can be determined by industry *and* country at each point in time. Moreover, when the intra euro zone volatility is brought to zero with the introduction of the euro (i.e., $\sigma_{1999}^{\text{euro}}$ converges toward zero), it provides a simple measure of the impact of this change on the production structure. This measure is defined as follows:

¹² Breush-Pagan tests reveal that these random effects are highly significant. In addition, Hausman tests confirm the appropriateness of random effects. The random-effect estimators never differ significantly from the fixed-effect estimators at a level 0.01.

¹³ The time dummies will have an important influence on the size of the impact, reducing it by a factor of 4–5 for the whole region (i.e., the previous version estimated a substantial negative impact of the order of 1 percent of GDP. We now have a moderate negative impact of the order of 0.20 percent to 0.25 percent of GDP). The qualitative results remain largely unaffected, though.

$$Impact = -b_i \frac{x_{ja} - x_j}{x_j} s_i = -b_i Q_j s_i \quad (10)$$

where b_i is the random-effect estimator from the regression, s_i is the long-run share (or sample time average) of industry i in GDP, x_{ja} is the sample time average of $\ln \omega_{jt}$ after the introduction of euro.¹⁴

Hence, V_{ijt} / Y_{jt} is called value-added, and $\omega_{jt} (\sigma_t^{euro})^2$ is called euro-volatility, and X_{ijt} / Y_{jt} is called export performance, for short.

A. Industrial Panel Data

An industrial panel data is constructed for 45 countries. This section presents the panel data for the MENA region. The panel includes two cross-sectional dimensions and a time-series dimension. For the value-added regressions, there are between 1 and 34 time points for 11 industries and 14 MENA countries.¹⁵ For the trade regressions, there are between 21 and 23 time points for 11 industries and 14 MENA countries.¹⁶

The agricultural sector currently represents between 0.25 percent and 25 percent of the GDP in the MENA region. Algeria, Egypt, Iran, Morocco, Syria, and Tunisia have a higher share than regional average of 14 percent (upper line in Figure 1). These countries, particularly the North African countries trading with the euro zone, tend to be potentially more sensitive to euro volatility (lower line in Figure 1).

The crude oil and minerals sector (which also includes natural gas) varies greatly over time and across countries in the region. However, since relatively few of these resources are being exported to the euro zone, the euro volatility is not likely to affect this sector. This is confirmed by the rather low variability of euro zone exchange rate volatility (Figure 2).

The manufacturing sector represents between 8 percent and 24 percent of the GDP. High ratios, above the 16 percent regional average, are recorded for Bahrain, Egypt, Jordan, Morocco, and Tunisia. Many of these manufactured goods are being exported to the euro zone. This introduces a more irregular euro-volatility line than in any other sector. Data within

¹⁴Hence, Q_j is the ratio of the sample average of $\ln[\omega_{jt} (\sigma_t^{euro})^2]$ over the sample average of $\ln(\sigma_t^{euro})^2$. The negative sign is introduced for convenience so that, for instance, an income effect $b_i < 0$ translates into a gain (+).

¹⁵Iraq and Qatar were excluded because data are not available.

¹⁶Libya and Oman did not have data available and thus were excluded.

manufacturing are available at the 2-3 digit level but were pooled into seven categories for consistency and clarity.¹⁷ Within manufacturing, the most prevalent industries are food products, chemicals (including petroleum refining), and basic manufacturing products; the least prevalent are machinery, textile, wood products, and steel (Figure 3).

Finally, the services sector represents a large share of GDP with a regional average of 50 percent. Since this sector also includes all nontraded goods, a flat slope of euro volatility was obtained, as in the case of crude oil and minerals sector (Figure 4).

An inspection of these sectors directly reveals that, if the euro volatility affects the region's production structure, its impact has to be channeled through the agricultural, manufacturing, and services sectors. Indeed, for the oil and gas sector, the large variance in value-added cannot be accounted for by the flat pattern of euro-volatility for this sector.

B. Evidence from Value-added

Empirical results show that the agricultural and services sectors, with a statistically significant net income effect, will gain from the introduction of the euro (Figure 5 and Table 2).¹⁸ In contrast, a statistically significant net substitution effect is found for the wood product and basic manufacturing product industries.¹⁹ While the wood product industry represents only a small share of manufacturing, the negative impact on basic manufacturing product industry is potentially damaging. Hence, the reduction of intra-euro volatility will hurt the industrialization of MENA countries. As expected, nonsignificant results are found for the oil, gas, and minerals industries, which exhibit large standard errors.²⁰

In general, the high value-added sectors, e.g., agriculture, in which MENA has a comparative advantage, gain at the expense of the low value-added sector in which MENA has a comparative disadvantage, e.g., basic manufacturing product industry.

For the MENA region as a whole, a moderate loss range of 0.18 percent to 0.28 percent of GDP is estimated. Despite net gains in the agriculture and service industries, the region is expected to suffer a loss of about 0.20 to 0.25 percent of GDP as a result of the introduction of euro and the deindustrialization it will cause (Table 3).

¹⁷See Table 1 for detailed composition of industries.

¹⁸A positive estimate for beta indicates a net substitution effect, which is expected to hurt the industry with the elimination of intra-euro volatility.

¹⁹Chemicals and machinery industries are very close to being significant at the 0.05 level.

²⁰The vertical lines in Figure 5 give the 95 percent confidence interval. An interval above the horizontal line indicates a net substitution effect, an interval below indicates a net income effect, and an interval cutting the horizontal line indicates nonsignificant results at 0.05 level.

The country-specific impacts are more striking. They reveal losses of 0.28 percent to 0.44 percent of GDP for Algeria; 0.29 percent to 0.46 percent for Libya; 0.29 percent to 0.45 percent for Morocco; and 0.30 percent to 0.47 percent for Tunisia. In the Middle East, Egypt, Iran, and Syria also exhibit higher losses than the regional average. The impact on all other countries in the region is more limited.

North African countries are clearly expected to lose from the introduction of the euro.²¹ The explanation is based on two factors: (i) a relatively high share of manufacturing sector; and (ii) a very high share of trade with the euro zone, well above the MENA average of 37 percent.

In sum, the introduction of the euro will hurt the industrialization of MENA countries, with losses being highest for countries that are more advanced in their manufacturing production and that trade of their manufacturing goods primarily with the euro zone. Hence, to insulate the domestic real economy from foreign financial volatility, countries need not only to diversify their production structure but also to diversify the destination of their exports.

IV. EXPORT PERFORMANCE

A. Regional analysis

The method applied to evaluate the impact of a reduced euro-zone exchange rate volatility on the export performance of MENA countries is identical to the model in equation 9, with one distinction. Here, the weighting variable ω_{jt} is not introduced. Hence, the impact of euro volatility amounts to the impact of $(\sigma_t^{\text{euro}})^2$ on the share of exports in GDP. Because of the high correlation of 0.72 between exports and value-added over the whole sample, the results do not differ substantially in the long run (Figure 6).²²

However, in the short run, exports are more volatile than value-added and are not limited to the 0-100 percent range. Therefore, the short-run impact is assessed in a standard fashion; the sample average of euro volatility is 1.831 and the standard deviation is 1.239. Hence, a conservative estimate of the short run impact of the euro on exports is given by $(x_i * 1.831 / 1.239)$, where x_i is the long-run or sample mean export share of GDP and shows that the euro volatility will fall by 1.478 standard deviations.²³ The aggregate rise in exports is estimated in the range of 0.04 percent to 0.22 percent of GDP for the whole region (Table 4). The rise in

²¹The case of Libya is less compelling because of lack of data on value-added for the post 1986 period.

²²The vertical lines give the 95 percent confidence interval. An interval above the horizontal line indicates a net substitution effect, an interval below indicates a net income effect, and an interval cutting the horizontal line indicates nonsignificant results at 0.05 level.

²³This method underestimates the impact since it downplays the recent relatively high values of euro volatility.

exports is driven by the expected increases in exports of agriculture and food product industries.

In sum, the evidence provided by trade data will which are known to be much more reliable than value-added data, confirms the deindustrialization impact of the euro (i.e., manufacturing industries will lose and agricultural industries will gain). The industries affected by the introduction of euro will experience changes in value-added and likely more important changes in exports, both in the same direction (with the exception of the food products industry). The statistical significance of the results suggest that, while the production structure is negatively affected by important changes in the basic manufacturing products industry, the export performance is negatively affected by important changes in the chemical industry instead. In both cases, however, the manufacturing sector appears as the loser while the agricultural and service sectors as the gainers (for the services sector, the results are not significant for exports, undoubtedly due to a high share of nontradables).

B. Interregional Analysis

Because a substantial difference was found as to the results between the Middle East (ME) and North African (NA) regions, this section attempts to compare the impact of the elimination of euro volatility on these two regions with that on the West African (WA), other Mediterranean (OM), and euro zone (EZ) regions. The goal is to confirm the results obtained so far for a larger sample of countries. A complete list of countries is provided in Table 7.

In order to deal properly with the heterogeneity of the panel, an industry-by-industry random effect estimation is performed.²⁴ To highlight the regional differences, both the slope and the intercept are allowed to vary by region. Rewriting equation 9, the empirical model becomes where the variables are defined as before.

$$y_{ijt} = \alpha_{i/region} + v_j + \delta_t + \beta_i x_{jt} + \beta_{i/region} x_{jt} + \epsilon_{ijt} \quad (11)$$

The estimation results and the implied measure of the impact of the elimination of intra-euro volatility are presented in Table 5 and 6. In these regressions, the euro-zone region is the benchmark. Agriculture, manufacturing industries, and services are expected to gain from the introduction of the euro; the evidence for natural resource (oil, gas, and minerals) industries are not significant at all. This is in accordance with the model as both the substitution and income effects favor the euro-zone region. The combined estimated net gain for the euro-zone region is 0.22 percent of GDP.

²⁴Breusch-Pagan tests rejects $H_0: \sigma_v^2 = 0$ at the level 0.01 in all cases. Hence, random effects are highly significant. In addition, random-effect estimators are not significantly different from fixed-effect estimators in all cases at the level 0.01.

Both the North Africa and Middle East regions have a significantly different impact than that in the euro-zone region in manufacturing (textile, basic, and steel) and services (Table 5). In addition, the North Africa region distinguishes itself from euro zone in machinery, while the Middle East region distinguishes itself from the euro zone in wood products. Therefore, the common slope (i.e., coefficient β_i) gives the size of the income effect and the coefficient on the regional slope (i.e., coefficient $\beta_{i/\text{region}}$) gives the substitution effect.

It follows that the *net* effect is the sum of these two coefficients for each region. Table 6 reports these sums assorted with a χ^2 statistic to test the significance of the net effect. The results confirm that the losses incurred by both Middle East and North Africa are localized and linked to the manufacturing industries, particularly, the basic manufacturing and the steel industries. North Africa suffers additional losses in the textile and machinery industries uncompensated for by the gains in agriculture, while the Middle East records additional losses in the wood product and chemical industries uncompensated for by the gains in services. This result gives a much more complete picture than the results for the region as a whole. Both agriculture and services would experience a gain in the MENA region after the introduction of euro; the agricultural gains are concentrated in North Africa, and the services gains in the Middle East. The basic manufacturing is the major industry for which there is a substantial net substitution effect; it brings in important losses for the Middle East and North Africa, as well as for West Africa.

By comparison, the other Mediterranean region suffers smaller losses in manufacturing and important compensating gains in services. This region appears to be a net gainer from the introduction of the euro. Since the West Africa region technically shares the same currency as the euro zone, it seems reasonable to expect that the substitution effect will not be damaging. Indeed, the results show that in West Africa all industries, except basic manufacturing industry, remain insulated from changes in euro volatility. Hence the West Africa region should not suffer significant losses as a result of the introduction of euro.

In sum, other Mediterranean countries, which benefit from a more diversified manufacturing production structure, and West Africa which technically shares the same currency as the euro zone, may both end up either unaffected or net gainers from the introduction of euro.

V. SUMMARY AND CONCLUSIONS

This paper investigates the impact of the elimination of intra-euro volatility on the production structure and export performance of MENA countries. The empirical estimation using an industrial panel data shows compelling evidence regarding this financial-real linkage. Furthermore, the estimation, which rests on a novel theory of exports under uncertainty, is done without having to resort to the use of arbitrary measures of trade elasticities.

- At the aggregate level, the estimation for the MENA region reveals:
 - A net favorable income effect in the agricultural and services sectors.
 - A net unfavorable substitution effect in the manufacturing sector.
 - Nonsignificant results for oil, gas, and minerals sectors.
- Due to dominant substitution effects, the region as a whole is expected to suffer a loss of about 0.20 percent of GDP. The estimated impacts for individual countries clearly show that North African countries are expected to suffer the most with losses ranging from 0.25 percent to 0.28 percent of GDP. For Middle Eastern countries, the estimated range for the losses is smaller, 0.08 percent to 0.13 percent.
- Further disaggregation within the manufacturing sector reveals:
 - A net substitution effect in the steel, wood product, textile, machinery, and chemicals industries which are thus expected to be adversely affected by the introduction of the euro.
 - Results obtained on the food products industry are ambiguous.
- Regarding export performance: the estimates for the food products industry show that, although the substitution and income effects offset each other, the exports of the industry are expected to rise. Together with greater exports in agriculture and services (which gain from the net income effect), the overall export performance of the MENA region can be enhanced in the range of 0.04 to 0.20 percent of GDP.
- Comparing the results with those of other regions highlights two elements that *prevent* the production structure in these regions from being affected by the introduction of euro:
 - In other Mediterranean countries, the existence of a relatively diversified manufacturing production structure.
 - In Western Africa, the existence of technically a common currency with the euro zone.

Figure 1: The Agricultural Sector in MENA Countries 1960-97
(Value-added, upper line, and euro volatility, lower line)

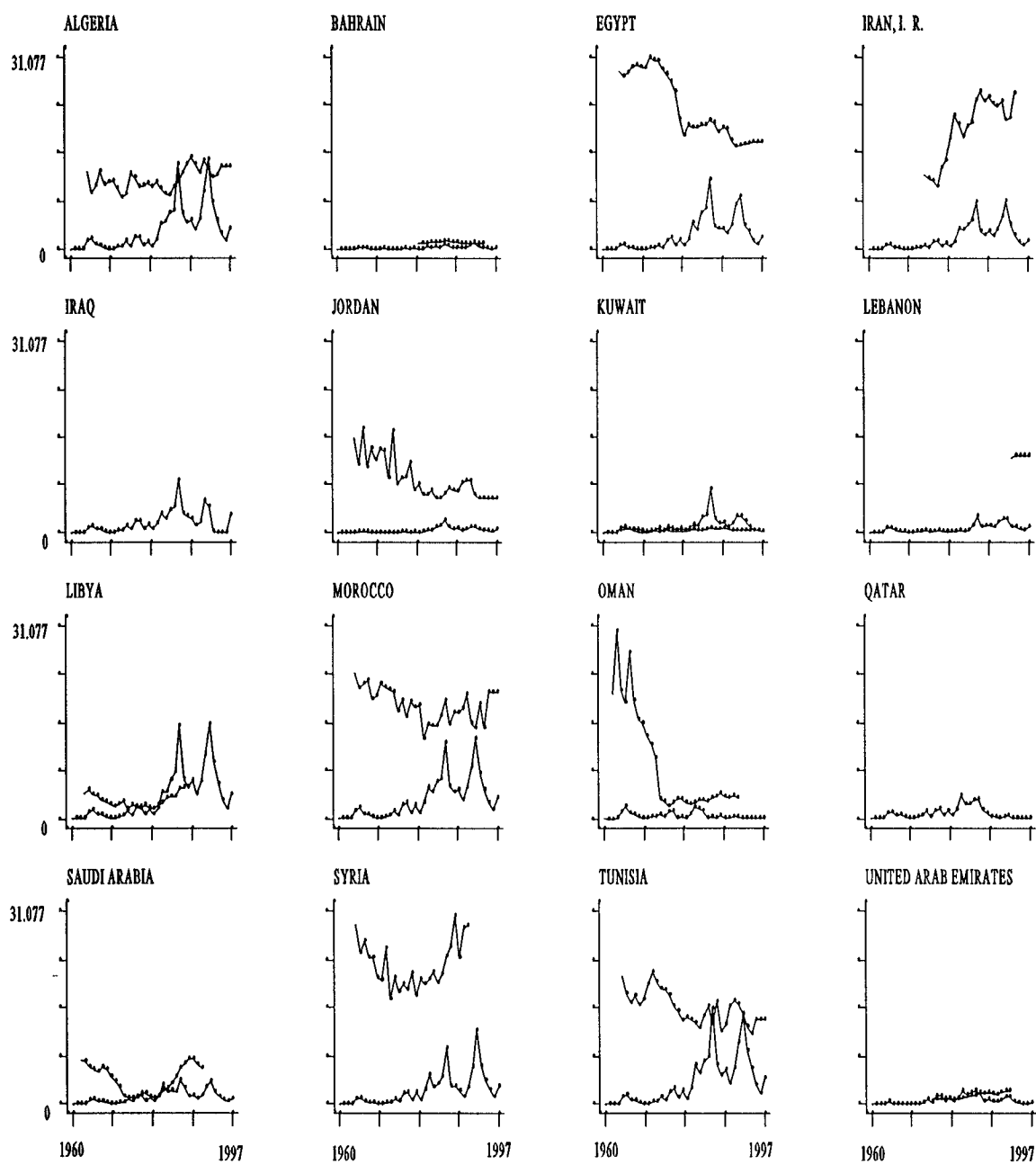


Figure 2: Oil, Gas, and Mineral Sector in MENA Countries, 1960-97
(Value-added, upper line, and euro volatility, lower line)

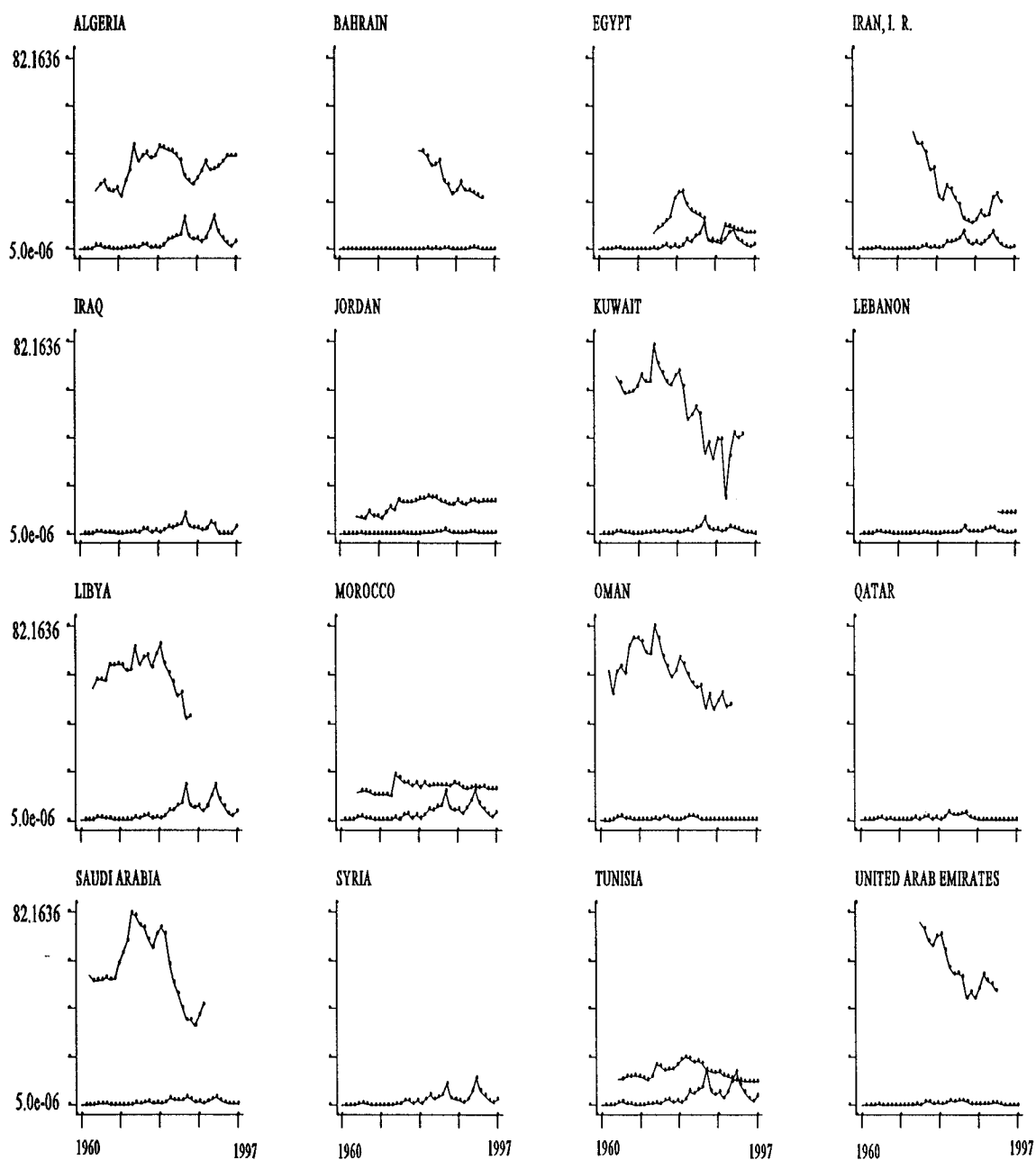


Figure 3: Manufacturing Sector in MENA Countries 1960-97
(Value-added, upper line, and euro volatility, lower line)

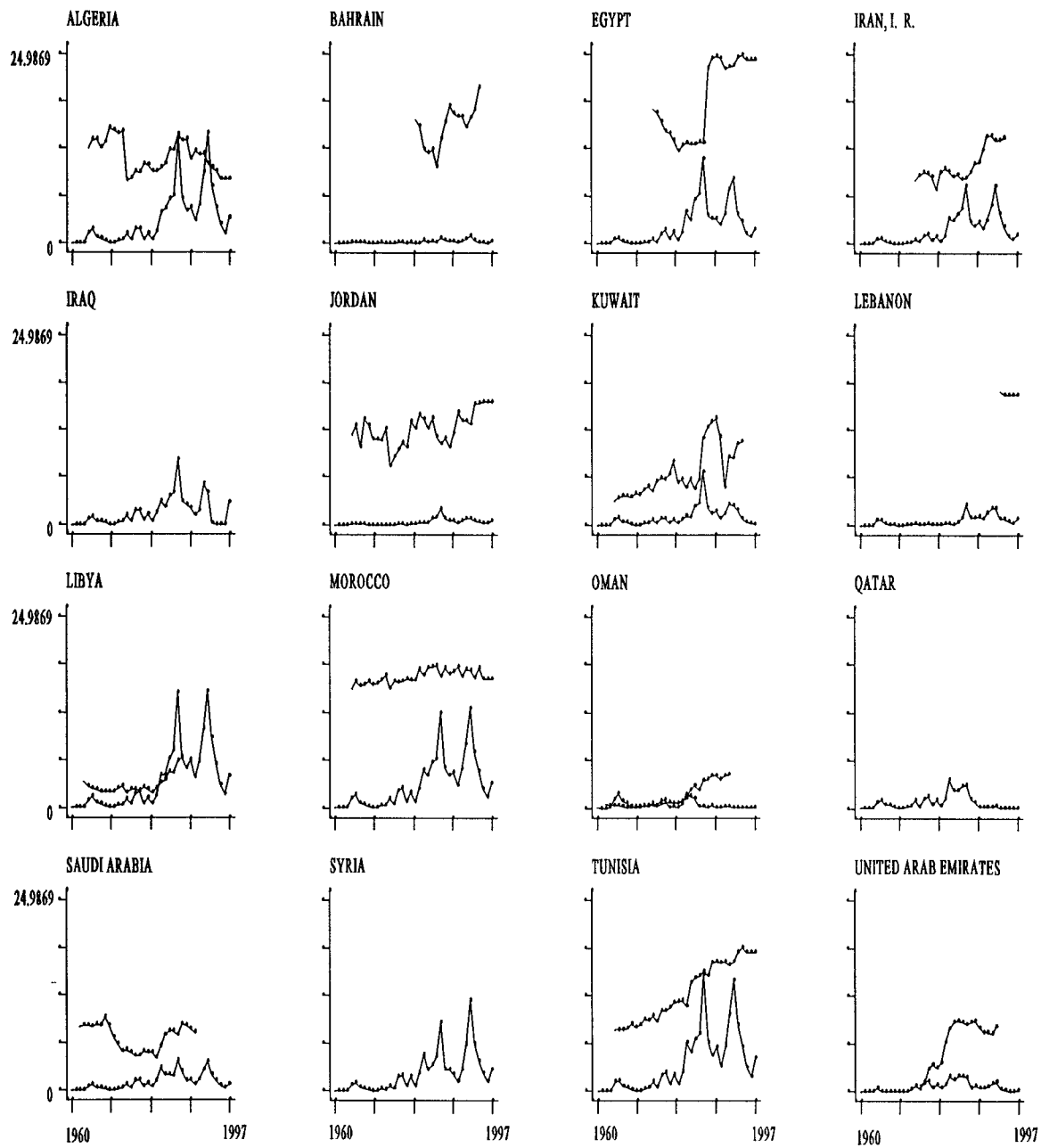


Figure 4: Service and Nontradables Sectors in MENA Countries 1960-97
(Value-added, upper line, and euro volatility, lower line)

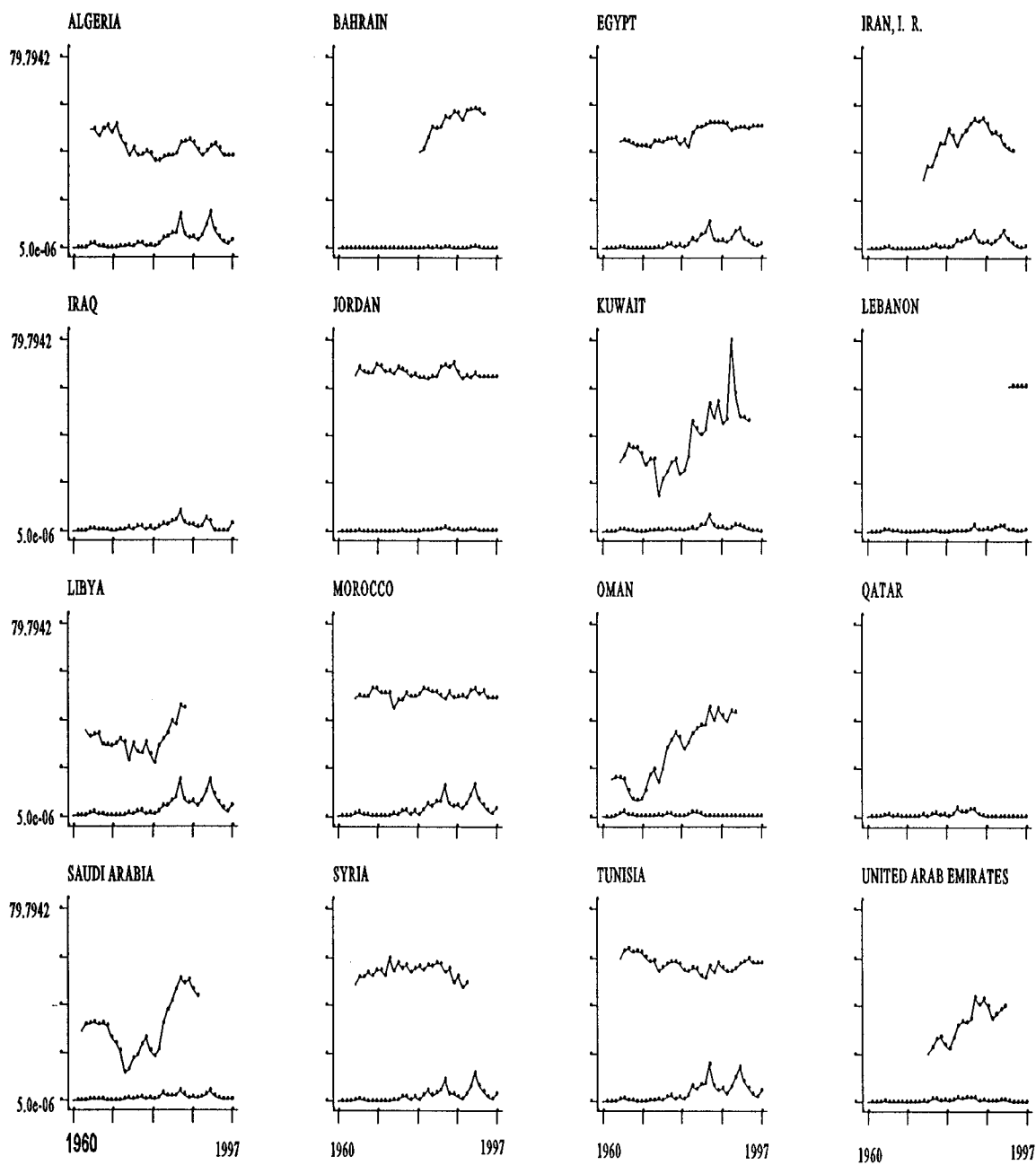


Figure 5: Industrial Sector:
Estimated beta for Production Structure in MENA

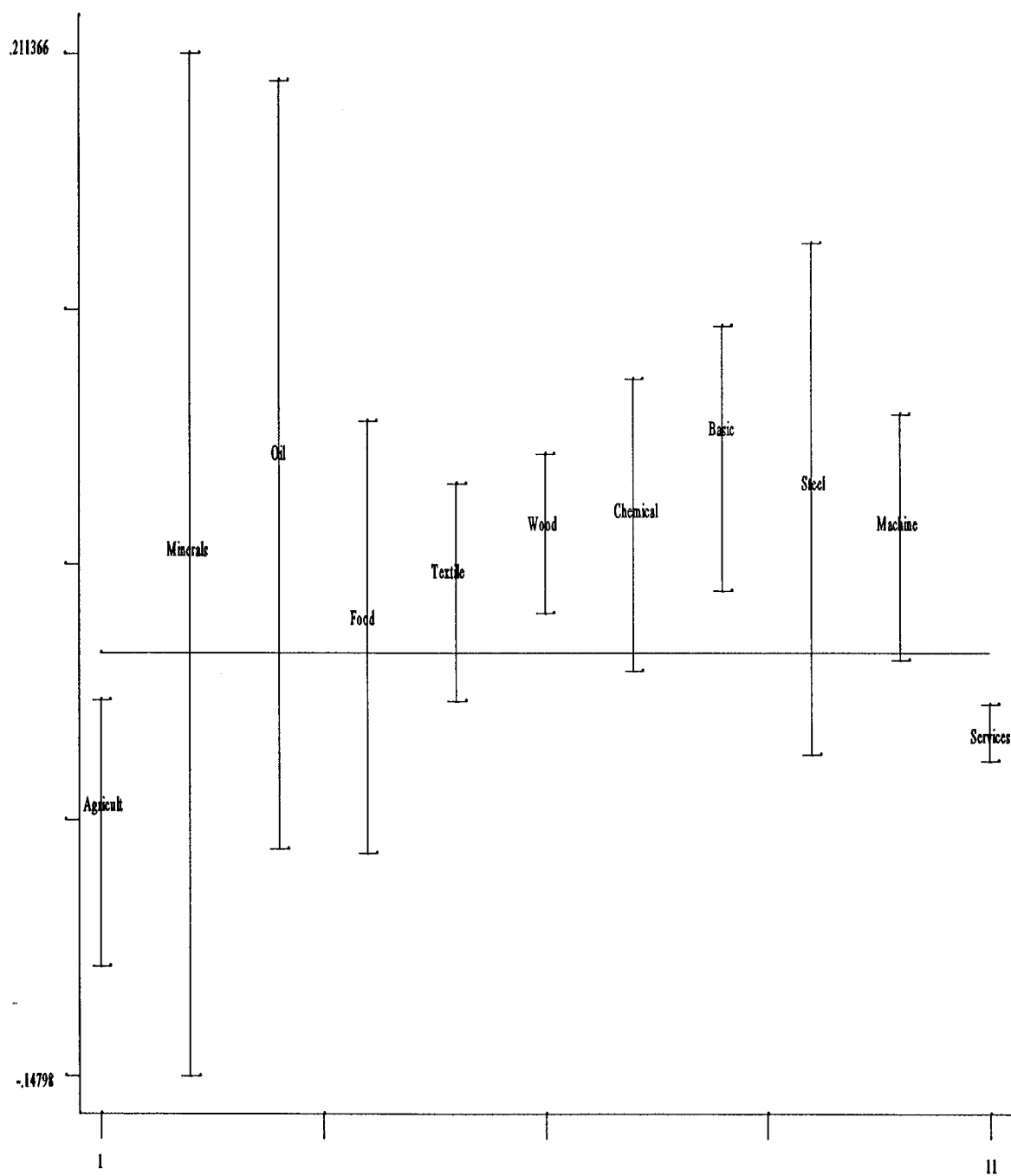


Figure 6: Industrial Sector:
Estimated beta for Export Performance in MENA

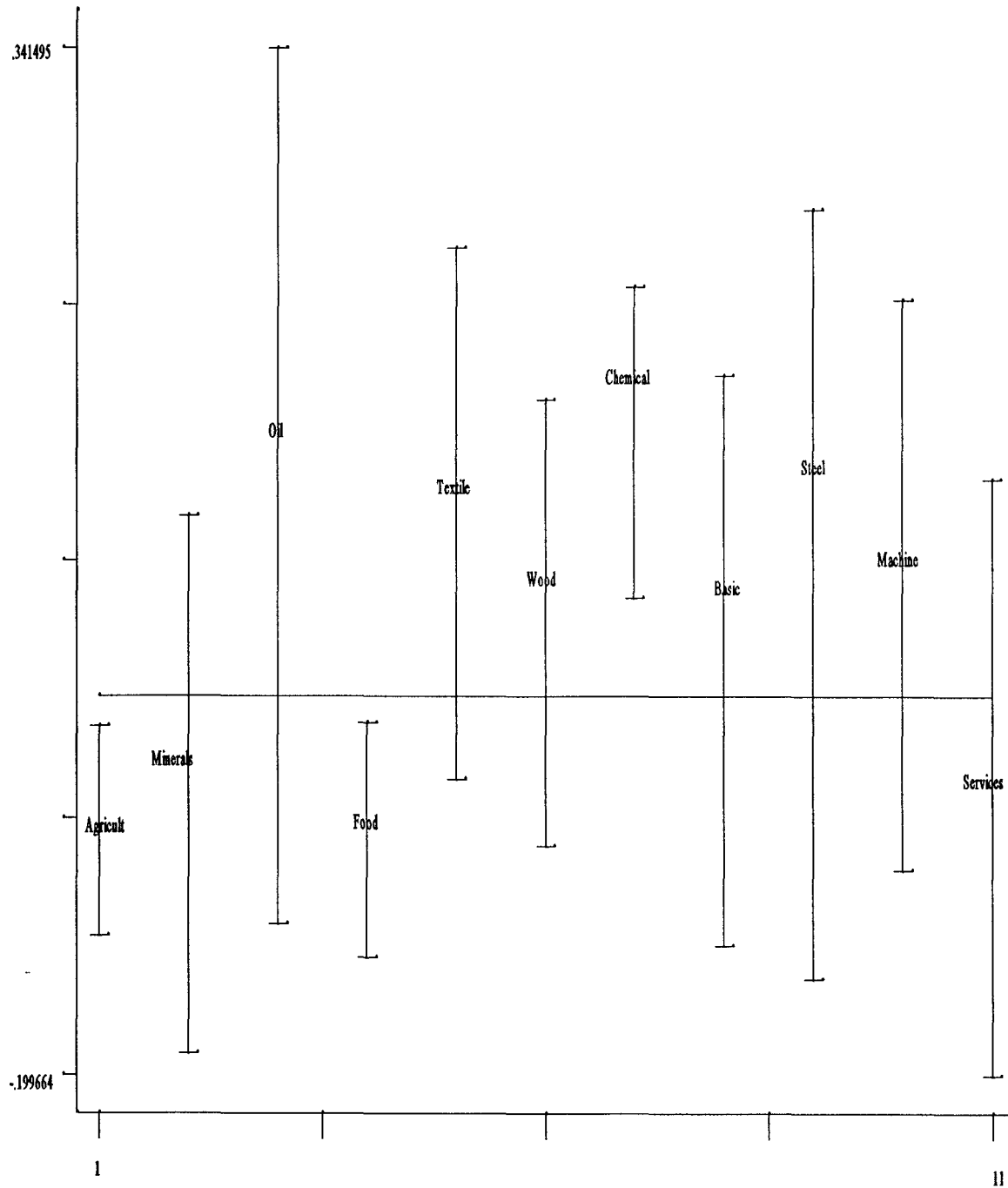


Figure 7: Intra-euro Exchange Rate Volatility
(Standard deviation of month-to-month bilateral exchange rate in euro zone)

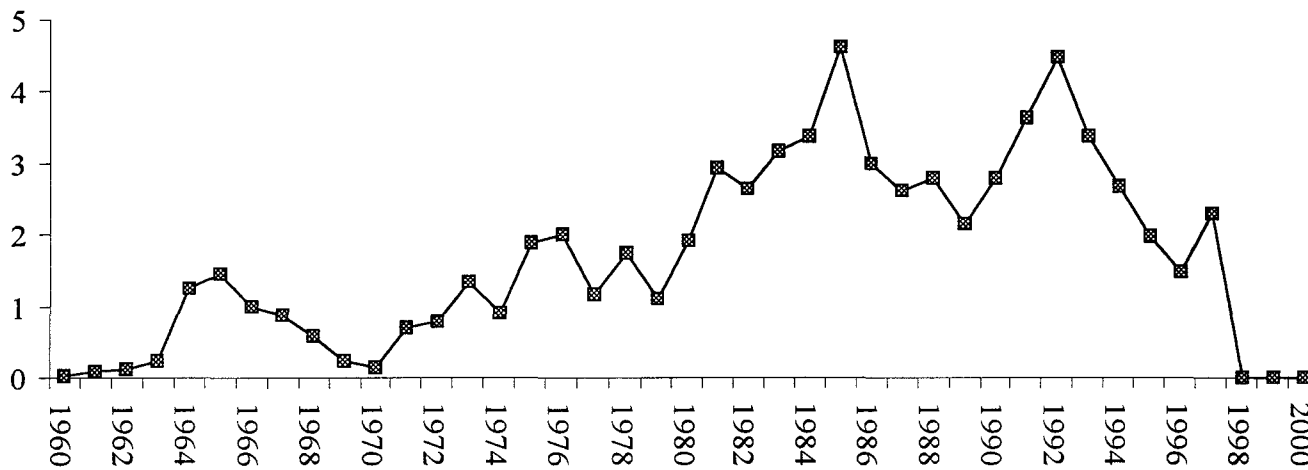


Table 1. Industrial Composition

			ISIC	Rev.3
1	Agriculture	Agriculture		01-05
2	Minerals	Minerals		10, 12-14
3	Oil & gas	Crude petroleum and natural gas		11
4	Food	Food products, beverages, tobacco	311-314	15-16
5	Textile	Apparel, leather products, footwear	321-324	17-19
6	Wood	Wood products, furniture, paper products, publishing	331-342	20-21
7	Chemical	Chemicals, petroleum refineries	351-354	24
8	Basic	Rubber, plastic, glass, non-metallic and other products	355-369, 390	25-26
9	Steel	Iron, steel, non-ferrous metals	371-372	27-28
10	Machinery	Machinery, electric, transport, profesional, scientific equipment	381-385	29-35
11	Services	Services		40-60

Table 2. Estimation of the Impact of Intra-Euro Volatility on the Production Structure for MENA Region
Dependent variable: ln (value-added share of GDP)

	Agriculture	Minerals	Oil & gas	Food	Textile	Wood	Chemicals	Basic	Steel	Machinery	Services
Industry intercept	1.746 *** (0.407)	-3.030 *** (0.619)	0.923 (0.917)	0.226 (0.316)	-0.365 (0.479)	-0.772 *** (0.285)	-0.006 (0.281)	-0.359 (0.237)	-2.215 *** (0.575)	-0.326 (0.315)	3.596 *** (0.130)
ln (intra-euro volatility)	-0.063 *** (0.024)	0.032 (0.092)	0.067 (0.069)	0.006 (0.039)	0.022 (0.020)	0.042 *** (0.014)	0.045 (0.026)	0.069 *** (0.024)	0.055 (0.046)	0.041 (0.022)	-0.028 *** (0.005)
Chi2	51.68	102.51	195.48	263.44	201.21	318.26	338.86	399.73	1451.64	2823.34	158.45
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Number of countries	14	13	13	13	13	14	14	13	12	13	14
T-min	5	5	5	1	1	1	1	1	1	1	5
T-bar	26.64	25.69	25.69	18.38	17.69	16.93	16.29	18.23	17.42	18.00	26.57
T-max	34	34	34	31	31	31	31	31	31	31	34
Number of observation	373	334	334	239	230	237	228	237	209	234	372
Impact on value-added for the region											
Implied gain (+) or loss (-) in percent	0.07	-0.01	-0.04	0.00	-0.01	-0.11	-0.01	-0.15	-0.02	-0.01	0.01

Notes: Robust standard errors are in parenthesis. *** statistically significant at the .01 level; ** statistically significant at the .05 level. A negative coefficient for ln (intra-euro volatility) indicates a net income effect, a positive coefficient a net substitution effect. Breusch-Pagan Lagrangian multiplier test for country random effects are significant at the .01 level for all industries. Hausman specification tests for appropriateness of the random-effects estimators consistently fail to reject the null of equality of the coefficients estimated by fixed- and random-effects estimators at the .05 level for all industries. Post-1979 time dummies are included but not reported.

Table 3. Measure of Impact for MENA Countries
Gains (+) and Losses (--) as Percentage of GDP in MENA Countries

			Agriculture	Minerals	Oil & gas	Food	Textile	Wood	Chemicals	Basic	Steel	Machinery	Services
		Beta - coef.:	-0.063 ***	0.032	0.067	0.006	0.022	0.042 ***	0.045	0.069 ***	0.055	0.041	-0.028 ***
	TOTAL RANGE						(In Percent)						
ALGERIA	-0.28	-0.44	0.11	-0.01	-0.06	0.00	-0.01	-0.17	-0.02	-0.24	-0.03	-0.02	0.02
BAHRAIN	-0.05	-0.07	0.02	0.00	-0.01	0.00	0.00	-0.03	0.00	-0.04	-0.01	0.00	0.00
EGYPT	-0.23	-0.36	0.09	-0.01	-0.05	0.00	-0.01	-0.14	-0.02	-0.20	-0.03	-0.02	0.02
IRAN, I. R.	-0.21	-0.32	0.08	-0.01	-0.04	0.00	-0.01	-0.13	-0.01	-0.18	-0.02	-0.02	0.02
IRAQ	-0.19	-0.29	0.07	-0.01	-0.04	0.00	-0.01	-0.11	-0.01	-0.16	-0.02	-0.01	0.01
JORDAN	-0.06	-0.10	0.03	0.00	-0.01	0.00	0.00	-0.04	0.00	-0.06	-0.01	0.00	0.01
KUWAIT	-0.15	-0.24	0.06	-0.01	-0.03	0.00	-0.01	-0.09	-0.01	-0.13	-0.02	-0.01	0.01
LEBANON	-0.10	-0.16	0.04	0.00	-0.02	0.00	0.00	-0.06	-0.01	-0.09	-0.01	-0.01	0.01
LIBYA	-0.29	-0.46	0.11	-0.01	-0.06	0.00	-0.01	-0.18	-0.02	-0.25	-0.03	-0.02	0.02
MOROCCO	-0.29	-0.45	0.11	-0.01	-0.06	0.00	-0.01	-0.17	-0.02	-0.25	-0.03	-0.02	0.02
OMAN	-0.08	-0.12	0.03	0.00	-0.02	0.00	0.00	-0.05	-0.01	-0.07	-0.01	-0.01	0.01
QATAR	-0.12	-0.19	0.05	-0.01	-0.03	0.00	0.00	-0.07	-0.01	-0.11	-0.01	-0.01	0.01
SAUDI ARABIA	-0.16	-0.25	0.06	-0.01	-0.03	0.00	-0.01	-0.10	-0.01	-0.14	-0.02	-0.01	0.01
SYRIAN	-0.24	-0.37	0.09	-0.01	-0.05	0.00	-0.01	-0.14	-0.02	-0.20	-0.03	-0.02	0.02
TUNISIA	-0.30	-0.47	0.12	-0.01	-0.06	0.00	-0.01	-0.18	-0.02	-0.26	-0.04	-0.02	0.02
UNITED ARAB	-0.10	-0.16	0.04	0.00	-0.02	0.00	0.00	-0.06	-0.01	-0.09	-0.01	-0.01	0.01
MENA	-0.18	-0.28	0.07	-0.01	-0.04	0.00	-0.01	-0.11	-0.01	-0.15	-0.02	-0.01	0.01

Notes: Computations are explained in the text. The minimum impact of the range is measured under H_0 at the .05 level and the maximum impact sums all net effects. A statistical margin of error can be approximated by the largest impact found with a non-significant coefficient: +/- .06% (see Oil and gas industry).

Table 4. Estimation of the Impact of Intra-Euro Volatility on Export Performance for MENA Region
Dependent Variable: ln (Export Share of GDP)

	TOTAL RANGE	Agriculture	Minerals	Oil & Gas	Food	Textile	Wood	Chemicals	Basic	Steel	Machinery	Services
Intercept		-0.996 (0.515)	-3.083 *** (0.568)	0.831 (0.883)	-0.539 (0.425)	-1.126 (0.576)	-2.722 *** (0.492)	0.130 (0.447)	-2.281 *** (0.458)	-2.823 *** (0.650)	-1.257 *** (0.480)	1.874 *** (0.252)
ln (intra-euro volatility)		-0.071 *** (0.028)	-0.047 (0.072)	0.111 (0.118)	-0.076 ** (0.032)	0.096 (0.071)	0.039 (0.060)	0.134 *** (0.042)	0.019 (0.077)	0.054 (0.103)	0.059 (0.077)	-0.043 (0.080)
Chi2		87.73	100.24	150.29	94.28	157.82	62.92	138.88	110.80	147.64	121.03	82.51
Prob > chi2		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Number of countries		14	14	14	14	14	14	14	14	14	14	14
T-min		21	21	21	21	21	21	21	21	21	21	21
T-bar		22.79	22.86	22.79	22.79	22.79	22.79	22.79	22.79	22.86	22.86	22.79
T-max		23	23	23	23	23	23	23	23	23	23	23
Number of observation		319	320	319	319	319	319	319	319	320	320	319
Impact on exports for the region												
Implied gain (+) or loss (-)	0.04 0.22	0.23	0.21	-0.14	0.07	-0.09	-0.05	-0.08	-0.02	-0.06	-0.06	0.02

Notes: Robust standard errors are in parenthesis. *** statistically significant at the .01 level; ** statistically significant at the .05 level. A negative coefficient for ln (export share of GDP) indicates a net income effect; a positive coefficient a net substitution effect. Breusch - Pagan Lagrangian multiplier test for random effects are significant at the .01 level for all industries. Hausman specification tests for appropriateness of the random-effects estimators consistently fail to reject the null of equality of the coefficients estimated by fixed- and random-effects estimators at the .05 level for all industries. Post-1979 time dummies are included but not reported. The minimum impact of the range is measured under Ho at the .05 level and the maximum impact sums all net effects.

Table 5. Estimation of the Impact of Intra-Euro Volatility on Value-Added For all Regions

Dependent Variable: ln (Value-Added Share of GDP)

	Agriculture	Minerals	Oil & gas	Food	Textile	Wood	Chemicals	Basic	Steel	Machinery	Services
ln (intra-euro volatility)	-0.040 *** (0.013)	0.045 (0.052)	-0.068 (0.117)	-0.010 (0.021)	-0.072 ** (0.033)	-0.017 (0.015)	0.016 (0.040)	-0.028 (0.022)	-0.091 *** (0.025)	0.016 (0.033)	-0.137 ** (0.025)
ln (intra-euro volatility)*WA	0.033 (0.022)	-0.123 (0.094)	0.070 (0.351)	-0.046 (0.058)	0.018 (0.129)	0.101 (0.072)	0.003 (0.072)	0.140 *** (0.053)	0.213 (0.135)	0.084 (0.079)	0.105 ** (0.020)
ln (intra-euro volatility)*NA	-0.003 (0.023)	-0.031 (0.099)	0.071 (0.084)	0.038 (0.072)	0.167 (0.050)	0.026 (0.024)	-0.037 (0.042)	0.203 *** (0.035)	0.325 *** (0.030)	0.099 *** (0.036)	0.141 *** (0.028)
ln (intra-euro volatility)*ME	0.048 (0.030)	0.070 (0.086)	0.017 (0.097)	0.054 (0.058)	0.109 ** (0.046)	0.083 *** (0.028)	0.073 (0.044)	0.128 *** (0.036)	0.252 *** (0.048)	0.056 (0.056)	0.087 *** (0.033)
ln (intra-euro volatility)*OM	0.025 (0.029)	-0.118 (0.123)	0.060 (0.249)	0.041 (0.026)	0.193 *** (0.048)	0.086 *** (0.028)	0.069 (0.053)	0.043 (0.047)	0.084 (0.067)	0.091 ** (0.044)	0.009 (0.026)
Chi2(5) for regional dummies Prob > chi2	766.720 0.000	64.640 0.000	77.550 0.000	248.710 0.000	130.040 0.000	115.180 0.000	114.100 0.000	178.560 0.000	25.650 0.000	307.450 0.000	13189.480 0.000
Chi2(28) Prob > chi2	280.64 0.000	75.38 0.000	98.77 0.000	138.58 0.000	422.15 0.000	199.00 0.000	120.67 0.000	361.39 0.000	272.66 0.000	226.85 0.000	202.32 0.000
"R2"-within	0.20	0.07	0.09	0.12	0.37	0.16	0.12	0.22	0.24	0.12	0.16
"R2"-between	0.54	0.20	0.36	0.34	0.32	0.57	0.28	0.56	0.47	0.68	0.25
"R2"-overall	0.50	0.19	0.31	0.31	0.32	0.59	0.36	0.50	0.41	0.65	0.19
Number of countries	39	34	38	38	34	37	36	34	28	36	35
T-min	5	1	2	1	1	1	1	1	1	1	5
T-bar	27.1	25.91	25.08	22.18	22	21.3	20.56	21.91	23.07	22.36	28.26
T-max	36	36	36	33	33	33	33	33	33	33	36
Number of observation	1057	881	953	843	748	788	740	745	646	805	989
Impact for Euro-zone: Implied gain (+) or loss (-) in percent	0.22	0.09	-0.05	0.08	0.00	0.01	-0.01	0.01	0.04	0.00	0.04

Notes: ME = Middle East countries; NA = North African countries; OM = Other Mediterranean countries; WA = West African countries.

IMPORTANT: Coefficients are deviations from the euro-zone benchmark. Robust standard errors are in parenthesis. *** statistically significant at the .01 level; ** statistically significant at the .05 level. A negative coefficient for ln (intra-euro volatility) indicates a net income effect; a positive coefficient a net substitution effect. Breusch - Pagan Lagrangian multiplier test for random effects are significant at the .01 level for all industries. Hausman specification tests for appropriateness of the random-effects estimators consistently fail to reject the null of equality of the coefficients estimated by fixed- and random-effects estimators at the .05 level for all industries.

Table 6. Measure of Impact on Value-added for all Regions
Gains (+) And Losses (--) as Percentage of GDP For All Regions

	TOTAL RANGE		Agriculture	Minerals	Oil & gas	Food	Textile	Wood	Chemicals	Basic	Steel	Machinery	Services
Beta coefficient for WA			-0.007	-0.078	0.001	-0.056	-0.054	0.084	0.019	0.111	0.122	0.101	-0.032
Chi2(1)			0.19	0.77	2.59	1.09	0.20	1.58	0.10	4.66	0.83	2.58	2.62
Prob > chi2			0.662	0.381	0.132	0.297	0.652	0.209	0.754	0.031	0.363	0.109	0.105
Beta coefficient for NA			-0.043	0.015	0.003	0.028	0.095	0.009	-0.020	0.175	0.234	0.116	0.003
Chi2(1)			5.28	2.91	0.00	0.19	4.93	0.18	2.10	31.49	45.16	24.58	0.01
Prob > chi2			0.012	0.150	0.980	0.667	0.026	0.670	0.148	0.000	0.000	0.000	0.903
Beta coefficient for ME			0.008	0.115	-0.052	0.045	0.037	0.066	0.090	0.100	0.161	0.072	-0.050
Chi2(1)			0.47	2.57	0.44	0.80	1.92	8.84	21.42	13.02	10.83	2.97	6.58
Prob > chi2			0.494	0.109	0.509	0.370	0.166	0.003	0.000	0.000	0.001	0.085	0.010
Beta coefficient for OM			-0.015	-0.072	-0.008	0.032	0.121	0.069	0.085	0.014	-0.007	0.107	-0.128
Chi2(1)			0.31	0.35	0.00	2.03	7.83	6.82	6.49	0.12	0.01	9.07	14.52
Prob > chi2			0.577	0.555	0.973	0.154	0.005	0.009	0.011	0.731	0.918	0.003	0.000
(In Percent)													
Impact for WA:			ns	ns	ns	ns	ns	ns	ns		ns	ns	ns
Implied gain (+) or loss (--)	-0.06	-0.02	0.01	0.12	0.00	0.02	0.03	-0.05	-0.01	-0.06	-0.05	-0.05	0.02
Impact for NA:				ns	ns	ns		ns	ns				ns
Implied gain (+) or loss (--)	-0.26	-0.28	0.07	-0.01	0.00	-0.01	-0.05	-0.01	0.01	-0.09	-0.13	-0.06	0.00
Impact for ME:			ns	ns	ns	ns	ns					ns	
Implied gain (+) or loss (--)	-0.08	-0.13	-0.01	-0.04	0.02	-0.01	-0.01	-0.02	-0.02	-0.02	-0.03	-0.02	0.00
Impact for OM:			ns	ns	ns	ns				ns	ns		
Implied gain (+) or loss (--)	-0.07	0.01	0.02	0.05	0.02	-0.01	-0.03	-0.02	-0.03	0.00	0.00	-0.03	0.05

Notes: ME = Middle East countries; NA = North African countries; OM = Other Mediterranean countries; WA = West African countries.

"ns" stands for non-significant, readily observable from the chi2 test: $H_0: \ln(\text{intra-euro volatility}) + \ln(\text{intra-euro volatility}) * \text{region} = 0$ from Table 4. The minimum impact of the range is measured under H_0 when the chi2 test is non-significantly different from zero at the .05 level. The maximum impact sums all net effects.

Table 7. List of Countries by Specified Region

WB		Country
AUT	EZ	AUSTRIA
BEL	EZ	BELGIUM-LUXEMBOURG
FIN	EZ	FINLAND
FRA	EZ	FRANCE
DEU	EZ	GERMANY
IRL	EZ	IRELAND
ITA	EZ	ITALY
NLD	EZ	NETHERLANDS
PRT	EZ	PORTUGAL
ESP	EZ	SPAIN
BHR	ME	BAHRAIN
EGY	ME	EGYPT
IRN	ME	IRAN, I.R. OF
IRQ	ME	IRAQ
JOR	ME	JORDAN
KWT	ME	KUWAIT
LBN	ME	LEBANON
OMN	ME	OMAN
QAT	ME	QATAR
SAU	ME	SAUDI ARABIA
SYR	ME	SYRIAN ARAB REPUBLIC
ARE	ME	UNITED ARAB EMIRATES
DZA	NA	ALGERIA
LBY	NA	LIBYA
MAR	NA	MOROCCO
TUN	NA	TUNISIA
CYP	OM	CYPRUS
GRC	OM	GREECE
ISR	OM	ISRAEL
MLT	OM	MALTA
TUR	OM	TURKEY
BEN	WA	BENIN
BFA	WA	BURKINA FASO
CMR	WA	CAMEROON
CAF	WA	CENTRAL AFRICAN REP.
TCD	WA	CHAD
COG	WA	CONGO, REPUBLIC OF
CIV	WA	COTE D IVOIRE
EQG	WA	EQUATORIAL GUINEA
GAB	WA	GABON
CPV	WA	GUINEA-BISSAU
MLI	WA	MALI
NER	WA	NIGER
SEN	WA	SENEGAL
TGO	WA	TOGO

1. Data sources

- Value-added for the major sectors (agriculture, oil & gas, minerals, services, and nontradables) and GDP were obtained from the World Development Indicators, World Bank, and the World Economic Outlook, IMF. The disaggregation of the manufacturing sector into 29 two-digit ISIC industries is found in the UNIDO Industrial Statistics Database, UN.
- Monthly exchange rates for the euro zone were obtained from the International Financial Statistics, IMF under the heading “ae”, end of period.
- Export data are measured by imports from the trading partners and come from two sources. Aggregate bilateral trade is drawn from the Direction of Trade Statistics, IMF, and the industrial trade data from the World Trade Database, Statistics Canada. These highly disaggregated trade data are included in the NBER CD-ROM on World Trade Flows, by Feenstra, Lipsey and Bowen (1997). Conversion of these SITC data into ISIC has been possible thanks to a concordance key provided by Daniel Trefler from University of Toronto.

2. Technical details

A. Derivation of equation 7: Expanding the second term in equation 6 requires the use of a simple tool of dynamic programming. The evolution of the optimal flow of value-added B_i is

$$dB = B_R dR + \frac{1}{2} B_{RR} (\sigma^{euro} R dz)^2$$

where B_R is the derivative of the Bellman function B_i with respect to R . Then, using equation 1, we can write

$$dB = B_R [(\sigma^{euro} + \sigma) R dz - R \mu dt] + \frac{1}{2} B_{RR} (\sigma^{euro} R dz)^2$$

which, in expectation, becomes

$$E[dB] = -R B_R \mu dt + \frac{1}{2} B_{RR} (\sigma^{euro})^2 R^2 dt$$

since $E[dz] = 0$ and $E[dz^2] = dt$. Dividing the equation by dt and plugging back in equation 6 in the text, yields

$$V = (\rho - \mu) B - R B_R \mu + \frac{1}{2} B_{RR} (\sigma^{euro})^2 R^2$$

,Finally using equation 4, taking the appropriate derivatives, and simplifying yields equation 7 in the text.

B. The simple rule directly follows from equation 5 and the definition of β :

$\beta_i > 0 \Leftrightarrow$ net substitution effect $\Leftrightarrow \eta_i > 1 \Leftrightarrow$ exporting industry have low $h_i \Leftrightarrow$ low value-added

Similarly,

$\beta_i < 0 \Leftrightarrow$ net income effect $\Leftrightarrow \eta_i < 1 \Leftrightarrow$ exporting industry have high $h_i \Leftrightarrow$ high value-added

Again, further details can be found in Ruhashyankiko (1998).

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