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**『The Economic Effects of the EU Budget:
A VAR Analysis』**

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The Economic Effects of the EU Budget: A VAR Analysis*

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Abstract

This paper analyzes the allocation, redistribution and stabilization role of the EU budget from 1976 to 2001. We use impulse responses from VAR models to infer the dynamic effect of a country's GNP on its disposable income — defined as GNP plus net EU budget transfers — both in the short run (stabilization) and in the long run (redistribution). In addition, we measure the allocation role of net budget transfers through their "dynamic multiplier" effect on a country's GNP, circumventing the difficult task of estimating allocation via costs and benefits of trade flows. By disaggregating our data by subperiod and by budget component, we discover how diverse the above effects can be in different decades and for different budget programs. Finally, our framework allows us to establish some additional stylized facts that help derive relevant economic relations and useful policy conclusions.

1 Introduction

The EU budget has often been at the center of the economic and political debate within the European Union. Its emphasis on agricultural support, its lack of true own resources (and the consequent paucity of contributions), the frequent tensions between expenditure needs and resource limitations are examples of the underlying conflict among member states over the role of the budget. While successive reforms have timidly tried to counterbalance the most patent shortcomings (reducing the agricultural share of expenditures, adding new revenue sources, rationalizing expenditures), the conflict on the budget still looms large. The accession of several relatively poor countries requires yet another effort to broaden the financial base of the budget while at the same time devising objective criteria to allocate (redistribute) the resources effectively. In fact, unlike most other federal budgets, the EU budget is still in a development phase and could undergo major changes in the future.¹ Unfortunately, much of the discussions on the role of the budget tend to be based directly on countries' net budget positions, rather than on the effective incidence of the budget on member countries.² The European Commission has repeatedly warned against conclusions on costs and benefits of membership based on net budget positions only. Yet, even economic analyses have often relied solely on net transfer balances to draw policy conclusions (e.g., Reichenbach 1983, Marchese and Martinez Oliva 1991).³

More recently, other studies have looked more formally at individual aspects of the budget but, as we argue below, they are plagued by econometric difficulties that may bias the results.⁴

A useful way to think about the role of the EU budget in implementing common policies is the standard classification in public finance and fiscal federalism of the allocation, the redistribution and the stabilization functions of a central state.

The allocation function reflects the provision of public goods⁵ through the EU budget flows: agricultural support, cohesion, trade "liberalization"....⁶ While standard theory prescribes that the financing of public goods provision should

¹Proposals to reform the EU budgetary system have been put forward from EU institutions and from scholars. Among the latter, an example is Buti and Nava (2003).

²For example, Agenda 2000, Commission (1998), and Commission (2002).

³Bare net budget positions represent the "formal" incidence of the budget. It has long been recognized that some corrections are needed to derive the "effective" incidence: non-allocatable funds such as administrative and development aid must be excluded; distortions, such as the "Rotterdam effect" of large customs duties accruing to transit members, must be accounted for; and the relation between net benefits charged and net benefits actually paid must be also taken into account.

⁴Best examples in this category are Domenech, Maudes and Varela (2000), de la Fuente and Domenech (2001)....

⁵Since most benefits of EU common policies are excludable to non-members, it would be more correct to talk about "club" goods. The distinction between "club" goods and pure public goods has consequences in terms of revelation of preferences, as we'll see below.

⁶Other common policies, such as monetary policy through the ECB, or common regulations are not reflected in budget flows. We adopt the standard in public finance to focus on public policies operating through the budget.

reflect the extent of the benefitting jurisdiction, the existence of at least three levels of authority (supranational, national and regional) and the conflict between a "federalist" and a "statalist" soul within the EU make it difficult to establish the proper allocation role of the EU budget. By analyzing the budget effect on each member's economy, we provide a quantitative base to assess the allocation performance of the EU budget. We can also measure the impact of different budget categories, and derive whether, say, guidance funds are more efficiency-enhancing than cohesion funds. In line with other authors,⁷ our approach is that, since the goal of public goods provision is an increase in efficiency, a better resource allocation must be reflected ultimately in a higher [growth rate of] output. As an added advantage, our measure is easily interpretable as an income multiplier, and can therefore be evaluated also in macroeconomic terms.

The redistribution function is the reshuffling of given overall resources among member states. Redistribution conflicts have marred the history of the EU budget from the beginning. This was due both to the reluctance of members that considered themselves as "net givers," and sought a "juste retour" from their contributions, and to the bias created by the agricultural policy, which supposedly redistributed according to criteria not well correlated with each country's aggregate income. Yet the economic literature mentions a few reasons to redistribute income, and they are the subject of various economic and political analyses.⁸ Two main rationales of redistribution emerge: one linked to equity considerations, aimed at reducing historical disparities across states or regions; the other — typical of the EU budgetary characteristics — consisting in a compensation à la Kaldor to member countries more hurt by the integration process. Within the sample range, we will be able to capture both equity and compensatory redistribution by analyzing the buffering of permanent shocks that took place during the latest quarter century.

Finally, the stabilization function is the counter-cyclical effect of both EU revenues and expenditures on member countries' income. The constraints imposed by the EMU on both monetary and fiscal policies of member states have revived the debate on the need of an EU-wide stabilization or insurance scheme against idiosyncratic shocks. Several proposals have been put forward, and the recent creation of a "Solidarity Pact" to counter national natural disasters is an interesting example. However, rigorous empirical analyses of stabilization dynamics are lacking.

Hence, this paper tries to integrate the analysis of redistribution with the much-called-for study of the allocation effects of the budget, and complements it with an analysis of stabilization. One of the reasons why not many formal studies of EU budget redistribution exist is because the benefits (costs) of the allocation function are supposed to dwarf the costs (benefits) of redistribution. In this paper, not only do we try to measure all the net benefits of the allocation, redistribution and stabilization effects of the budget, but we also do it in a formally consistent way. The use of a VAR methodology allows to treat the

⁷For instance, Begg (2000).

⁸See Begg (2000) and references therein.

three budgetary functions in a unified framework, while the longer EU budget dataset permits to overcome some limitations that plagued earlier studies.

Section 2 surveys the literature on the economic effects of the EU budget, and points out the advantages of our approach; Section 3 discusses the data. Section 4 presents the results for stabilization, redistribution, and allocation effects. It also studies — among other ancillary issues — whether unemployment plays a role in the pattern of budget flows. Section 5 concludes with the summary of results.

2 Comparison with the Literature

2.1 Previous studies

No previous formal study exists, to our knowledge, dealing with the three budgetary functions in a unified model; several analyses, however, have focused on individual aspects of the EU budget.

2.1.1 Allocation

The analyses of the allocation function of the EU budget fall generally into two broad groups: a) studies dealing with allocation benefits in general, such as Ardy (1988); b) studies focusing on specific expenditure programs, whose effects are analyzed in great detail (examples are Pereira 1997, Barry, Bradley and Hannan 2001).

Given the extent of our dataset, our study naturally belongs to group a). In fact, its purpose is to provide an overall assessment, across time as well as across expenditure programs, of the way the EU budget provides the public goods it has been assigned.

Ardy (1988) evaluates the net benefits from the EU budget by comparing the costs of common policies to the States with the costs of the same policies if financed nationally. For example, the benefits or costs of the classic CAP to a country are measured by multiplying net exports by the difference between EU and world prices. The percentage change in national income of shifting from national to community financing of common policies in 1982–1984 is positive for France, Netherlands, Ireland, Denmark and Greece, negative for the others, and averages 1% of GDP (unweighted). The distribution of net benefits parallels the distribution of CAP expenditures, given both the weight of CAP expenditures and the amount of the external levies.

Gretschmann (1998) carries out a similar analysis, where trade gains are used to compute additional national budget revenues, in turn a proxy for net benefits. It is apparent that such measures of national benefits mechanically assimilate trade gains to income gains, neglecting the general equilibrium repercussions stemming, for example, from trade diversion or from trade-driven productivity growth. As Begg (2000) states explicitly, a better measure of allocation efficiency

would be the change in real income caused by the common policies.⁹

2.1.2 Redistribution

While several documents exist that assess the degree of redistribution through the EU budget only based on net budget positions, some recent studies attempt a more rigorous estimation, along the lines of the seminal MacDougall Report (1977). Domenech, Maudes and Varela (2000) regress for the period 1986–1998 net transfers (and components thereof) on income in an equation of the following type:

$$\log NT_t^i = \lambda_0 + \lambda_1 \log Y_t^i + \lambda_2 \log Y_t^{it} + \lambda_3 d_t + \varepsilon_t^i$$

where NT_t^i are net transfers of country i at time t , Y_t^i is GDP in country i at time t , the term $\lambda_2 \log Y_t^{it}$ captures the time trend, d_t is a time dummy and variables are in per capita terms. As established in the empirical public finance literature (Bayoumi and Masson 1995, von Hagen 1992, Goodhart and Smith 1993), the specification in levels captures the redistributive component of fiscal flows (whereas, as we will see below, the specification in first differences focuses more on the stabilization aspect).

de la Fuente and Domenech (2001) carry out a similar exercise, where cross-section regressions like

$$nt^i - nt = \lambda(y^i - y) + \varepsilon^i \quad (1)$$

are estimated year by year by weighted least squares (with weights given by population sizes).¹⁰ Both studies reach the conclusion that the income coefficient — that is, the degree of redistribution through the EU budget — is sizable, conditional on the overall size of the budget. About 5% of any difference in PPP income per capita between a country and the EU average is redistributed. In addition, the degree of redistribution has tended to increase over time, and is mostly due to structural programs.

A second strand of the empirical redistribution literature — dating back to Bayoumi and Masson (1995) — adopts a different econometric specification, the "relative income approach", deemed superior to the "elasticity approach" outlined above. A typical formulation is:

$$\frac{Y^i + NT^i}{Y + NT} = \delta + \lambda \frac{Y^i}{Y} + \varepsilon^i \quad (2)$$

⁹A recent strand of the VAR literature aims at calculating fiscal multipliers as impulse responses of output to innovations in fiscal stance (see Blanchard and Perotti 2002, and Edelberg, Eichenbaum and Fisher 1999). However, to our knowledge, the state effects of federal fiscal flows, like the EU budget have not been studied yet.

¹⁰Variables here ($nt^i - nt$ and $y^i - y$) are measured as per capita per cent deviations from the EU aggregate.

where the regressand is relative disposable income, rather than net transfers.¹¹

While these papers have set the stage for a rigorous analysis of EU redistribution, they both suffer from econometric difficulties, mainly arising from the short length of the sample.

2.1.3 Stabilization

When adopting the previous specifications in first differences, it is possible to estimate the stabilization role of EU fiscal flows. For example, Bayoumi and Masson (1995) estimate

$$\Delta \left(\frac{Y^i + NT^i}{Y + NT} \right) = \delta + \lambda \Delta \left(\frac{Y^i}{Y} \right) + \varepsilon^i \quad (3)$$

The most recent line of empirical analysis of the EU budget stabilization is due to Sørensen and Yosha (1998), who tested a panel equation similar to the following:

$$\Delta y_t^i - \Delta (y_t^i + nt_t^i) = \nu_t + \lambda \Delta y_t^i + \varepsilon_t^i, \quad (4)$$

where lowercase sans-serif characters indicate variables in log-deviation from the corresponding aggregate. The specification in differences identifies the stabilization pattern, and at the same time takes care of unit roots in the data. For the period 1976–1986 the ρ coefficient turns out to be close to zero.

2.2 Our approach

In perusing the literature it becomes clear that measuring allocation, redistribution, and stabilization amounts to analyzing the interrelationship between a measure of income and of net transfers (or net transfers plus income), often expressed as deviation from the aggregate. Stabilization and redistribution reflect how each state's net transfers respond to income changes in the short-run and in the long-run, while allocation shows how each state's income responds to changes in its transfers components. Such interrelations can be easily captured in a (panel) VAR model of income and net transfers. In our basic three-variable VAR model, we consider separately the two main components of net transfers — the EU budget's revenue and expenditure — in order to infer the role of each component. The structural specification is:

$$\begin{bmatrix} a_{11}^0 & 0 & 0 \\ a_{21}^0 & a_{22}^0 & 0 \\ a_{31}^0 & a_{32}^0 & a_{33}^0 \end{bmatrix} \begin{bmatrix} \Delta y_t^i \\ \Delta \text{rev}_t^i \\ \Delta \text{exp}_t^i \end{bmatrix} = \sum_{l=1}^p A^l \begin{bmatrix} \Delta y_{t-l}^i \\ \Delta \text{rev}_{t-l}^i \\ \Delta \text{exp}_{t-l}^i \end{bmatrix} + \begin{bmatrix} \varepsilon_{y,t}^i \\ \varepsilon_{\text{rev},t}^i \\ \varepsilon_{\text{exp},t}^i \end{bmatrix} \quad (5)$$

¹¹Espasa (2001) — using specification (2) on the period 1995–1997 — finds that the EU budget redistributes negatively (-3.46% of a GDP change).

where A^l is a 3×3 matrix of coefficients, and Δy , Δrev , and Δexp are measures of country-specific growth in GNP, in revenues and in expenditures, respectively. $\Delta y \equiv \Delta \log y - \Delta \log Y$, $\Delta \text{rev} \equiv \Delta \log \frac{y}{y-r} - \Delta \log \frac{Y}{Y-R}$, $\Delta \text{exp} \equiv \Delta \log \frac{y-r+\varepsilon}{y-r} - \Delta \log \frac{Y-R+E}{Y-R}$, ε_y is a shock to country-specific *GNP* growth, ε_{exp} is a shock to expenditure growth, and ε_{rev} is a shock to revenue growth. Note that the structural VAR has a recursive structure: shocks to Δy_t^i are assumed to affect the other two variables contemporaneously, and shocks to Δrev_t^i are assumed to affect Δexp_t^i contemporaneously. This is consistent with EU budget rules: each country's contributions and expenditures are determined on the basis of economic activities level, and — due to the balanced-budget rule — expenditure payments are determined after contributions are known.

From the impulse responses of Δrev_t^i and Δexp_t^i to $\varepsilon_{y,t}^i$, we can infer the stabilization role of the EU budget. In addition, from the impulse responses of rev_t^i and exp_t^i to $\varepsilon_{y,t}^i$, we can infer the allocation role of the EU budget. Finally, from the impulse responses of y_t^i and Δy_t^i to $\varepsilon_{\text{rev},t}^i$ and $\varepsilon_{\text{exp},t}^i$, we can infer the allocation role of the EU budget in the long and short run, respectively.

In addition to these three-variable models, we also construct a two-variable model of income and net transfer, to be more consistent with past studies and to infer the overall role of net transfers. Further, we construct four-variable models of income, revenue, expenditure, and one component of revenue or expenditure, to infer the role of each component of revenue or expenditure. More details on the methodology are described in the Appendix.

Our analysis presents several advantages over the existing literature:

1. Data

To our knowledge, we use the longest dataset on EU budget flows by country ever appeared in academic publications. Our data panel ranges from 1976 to 2001, across all the EU member countries, and is broken down in 3 revenue items and 7 expenditure items. In addition, the data are consistent throughout, since they are drawn from the same source (Court of Auditors). Once transformed into PPP real per capita terms, they allow us to address econometric issues that were impossible to tackle in studies with shorter data ranges.

2. Econometric Issues

2.1 Fixed effects: Taking advantage of the panel structure of the data, we use variables in deviation from the aggregate; hence we are able to partial out time fixed effects and gain in efficiency.

2.2 Endogeneity: By using a multi-variable VAR system, we are able to contain the endogeneity problem that plagued most of the studies on budgetary functions based on single-regression models (see for example Domenech, Maudes and Varela 2000). In fact, we isolate in turn the effects of GNP on budget flows to measure redistribution and stabilization, and the effects of budget flows on GNP in estimating allocation.

2.3 Dynamics: By exploiting impulse responses, we can analyze the dynamic behavior of the allocation, redistribution and stabilization effects. This is important because it has been forcefully argued (Goodhart and Smith 1993) that

the discretionary component of fiscal variables responds with a lag to changes in income; indeed, we find that the stabilization effect of the budget persists for up to two years after the shock. In addition, stabilization policies without long run (redistribution) effects are often regarded as preferable (see again Goodhart and Smith, 1993), and a distinction between short run and long run persistence of stabilization items addresses that issue.

3. Model

3.1 Consistency: Our VAR model allows us to treat the three budgetary functions in a unified framework. This is important not only for formal consistency, but also for a very concrete reason. Indeed, one of the explanations why not many formal studies of EU budget redistribution exist is because the benefits (costs) of the allocation function are supposed to dwarf the costs (benefits) of redistribution. Measuring both of them in a unified model allows a comparison that may shed light on the issue. In addition, a joint analysis allows to examine the existence of trade-offs between redistribution and allocation. Furthermore, it makes it straightforward to compute the allocative efficiency of redistributive funds, which is a way to calculate income convergence across EU members.

3.2 Allocation: Our choice of a federal budget like the EU, with a zero balance requirement, together with the adoption of a VAR framework, allows us to better isolate the discretionary components of budget flows, in order to assess their allocative effect on GNP.

3.3 GNP: Our choice of GNP instead of the more commonly used GDP as a measure of country income allows us to factor out the effect of changes in net income flows from abroad.

3.4 Metric: We measure both the shocks and the responses in terms of GNP. This represents an obvious choice in estimating both the stabilization and the redistribution effects, because it indicates directly what we want to know, namely the fraction of GNP that is stabilized, or redistributed, after a unit GNP shock. But our metric is also an informative choice when we measure the allocation effects: indeed, computing the GNP change as a change in the ratio of a budgetary item in GNP terms amounts to calculating a sort of "dynamic multiplier" of autonomous budgetary expenditures.

4. Breakdowns

The availability of disaggregated budget data allows us to identify which particular budget item is responsible for any effect of interest. Hence we confirm, for example, that the price (or income) support mechanism provided by the EAGGF-Guarantee fund plays an important positive role in stabilizing and redistributing resources, but at the same time is detrimental to an efficient allocation of common resources.

3 The Data

Our EU general budget data range from 1976 to 2001. The mid-seventies is the moment since when — after a decade of growth of EU competencies — "a high-

level plateau of quasi-state activities can be observed.”¹² The data are based on the Court of Auditors’ classification methodology, contained in the Court’s Annual Reports on the General Budget. For the years 1976-1985, they are taken from Eurostat Review (various issues); the years from 1986 to 1997 were kindly provided by Rafael Domenech, and are detailed in Domenech et al. (2000); the years from 1998 to 2001 are taken directly from the Annual Reports, with the breakdown provided in Commission (various issues).

The data represent actual yearly revenue payments from, and operational expenditure payments allocated to member countries. Allocated expenditures refer to payments made, according to the benefit principle,¹³ and exclude administrative expenditures; the allocation among countries in general abstracts from expenditures for third parties, or impossible to attribute to individual members. As a consequence, revenues always exceed allocated expenditures. These data avoid many of the problems related to bare net position figures.¹⁴

The data only refer to the general budget, excluding flows related to the European Coal and Steel Community, the European Investment Bank, the European Development Fund.

The variables are disaggregated as follows. Operating expenditures are broken down into Agricultural Guarantee and Guidance Fund (EAGGF)-Guarantee, Agricultural Guarantee and Guidance Fund (EAGGF)-Guidance and Fisheries, Regional Development Fund (ERDF), Social Fund (ESF), Other Structural Funds, Cohesion Fund, and Other Expenditures. Revenues are broken down into Net own resources, VAT contributions, and Other Revenues (GNP-related resource and Others).

Income and auxiliary data (population, deflators, exchange rates, PPPs) are from EUROSTAT. Unemployment and labor force data are from OECD’s Economic Outlook.

4 Results

In order to properly interpret the results, it is important to keep in mind that all the variables are in real per capita PPPs, and are computed in deviation from their aggregate mean, year by year. The variables in tables appear either in log-levels (for redistribution and long run allocation) or in growth rates (log-differences) for stabilization and short run allocation; however, only the variables in log-levels (i.e., cumulative log-differences) are presented in the graphs. Finally,

¹²See Wessels (1997).

¹³That is, according to the beneficiary’s country.

¹⁴For a discussion of these issues, see Nava (1999). Note that the so called “Rotterdam effect”, namely the disproportionate import duties — and hence EU budget contributions — paid by “ports of entry” such as Holland, is typically overestimated (e.g., in Verbeke et al. 1998). Indeed, an “inverse Rotterdam effect” exists, generated by disproportionate export subsidies — and hence EU agricultural funds — accruing to “ports of entry”, which counterbalances the previous effect. A further offsetting role is played by the allocation benefits stemming from internal trade of imported products, which has been estimated by Ardy (1988). In any case, our use of variables in first differences effectively addresses the problem.

when examining impulse responses it must be kept in mind that the scales of the graphs are adapted to fit the responses in the windows, and may therefore differ from each other.

4.1 Stabilization effects

For the entire sample, fig.1 illustrates in the first column the impulse responses of EU revenues and expenditures to *GNP* shocks. The names of the shocked variables are reported at the top of each column while the name of the responding variables are indicated at the far left of each row. The responses are over an eight year horizon, and dotted lines are one standard error bands.

It is interesting to note that the typical idiosyncratic *GNP* growth shocks are large (impact change is about 2.4%), and exhibit a slight serial correlation. The pattern of idiosyncratic *GNP* shocks across EU countries has an interest in itself. Economists have hotly debated on the likely effect of EU policies on the size of asymmetric *GNP* shocks. The European Commission (1990) defended the view that market integration would favor the homogeneization of economies and, hence, of shocks; on the other hand, economists like Krugman (1991) argued that the likely pattern of specialization following the internal market completion would favor the surge of specialized industrial clusters, each subject to a different type of sectoral shock. Our results — which are conditional on EU budget policies — lend support to the Commission’s view. Subperiod responses in fig. 2, 3 and 4 show that the decade after 1992 has witnessed asymmetric *GNP* shocks that have been half the size of those prevailing in the previous decade.

For stabilization to take place, member countries experiencing a rise in their *GNP* growth rate, with respect to the EU average, are expected to see an increase in contributions growth, and a fall in benefits growth compared to the average. Table 1 presents exact (normalized) numbers of the stabilization measure that is discussed in the Appendix. Revenues do not play a relevant role, whereas expenditures provide a more significant stabilization: 1.5% and 2.6% of country-specific *GNP* growth changes are smoothed on impact and at two-year horizon, respectively.

Relative to the comparable stabilization effect of the US Federal budget on state income (about 14%),¹⁵ the EU budget provides a negligible degree of buffering against member countries’ contingencies. However, dividing the sample into subperiods yields quite diverse results. In 1976–1985, the two-year effect amounted to 7.5%, all expenditure-driven (fig. 2); in 1984–1993, expenditures tended to rise with *GNP*, generating a destabilization of -2.5% (fig. 3); in 1992–2001, the total effect reached 9.1% (fig. 4).

It is instructive to examine the disaggregation of expenditures. Table 1 shows that agricultural expenses, namely the guidance and, especially, the guarantee funds play an important role, whereas a minor role is exerted by other nonstructural expenses. In other words, while the risksharing component —

¹⁵See Asdrubali and Kim (2004).

current transfers — does provide stabilization, on the contrary the intertemporal smoothing component — capital transfers (guidance, regional and cohesion funds)¹⁶ — is even slightly negative after two years.

The dynamics of budget components help address policy relevant issues. Goodhart and Smith (1993) have advocated for the EU the adoption of stabilization policies which exhibit little or no long-run (redistributive) effects, to avoid conflicts on equity considerations. Our results provide possible solutions to this issue: from the figures and Table 1, we can conclude that guidance funds and internal/external policies stabilize expenditures with much lower redistributive effects (unlike, for example, guarantee funds, which increase their effect over the long run); among revenues, net own resources provide impact stabilization but definitely no long run redistribution.

4.2 Redistribution effects

As discussed in Section 2, the long run cumulative responses, which represent the long run level responses, provide a measure of redistribution, in terms of the long run evolution of budgetary compensations and risksharing with respect to the EU average.

Fig. 1 confirms that idiosyncratic *GNP* shocks are permanent: after an impact jump, *GNP* rises in the second period too, levelling off at a higher steady state. Country-specific revenues follow a similar dynamics, but in the long run their level barely reaches 0.4% of the *GNP* increment. Country-specific expenditures fall instead by 2.2% of the *GNP* increment, thus representing a more effective redistributive tool than revenues.¹⁷

Dividing the sample into subperiods sheds light on differences in the redistribution function over time. The most striking difference emerges from comparing expenditure dynamics in fig. 2 and 3: in the former (sub-period 1976–1985), expenditures follow the usual pattern and end up redistributing 3.2% of idiosyncratic *GNP* (though standard errors are not very small); in the latter, instead (sub-period 1984–1993), expenditures exhibit again a "perverse" behavior, transferring 3% of idiosyncratic *GNP* to countries that had become richer. Analyses covering the most recent decade (fig. 4) show a reversal of this phenomenon to a more "normal" pattern, with expenditure redistribution rising to a whopping 10.6% of idiosyncratic *GNP*.... The change in revenue dynamics over time — also well documented by fig. 2, 3 and 4 — is far less dramatic, but the 1984–1993 period witnesses also a reduction in the redistributive power of revenues (oddly paralleled in recent years).

To learn which components of expenditures and revenues are responsible for these dynamics, we examine fig. 2, 3 and 4, as well as Table 2. This evidence shows how agricultural expenditures (especially Guarantee) — besides their stabilizing effect — also provide the bulk of redistribution. Interestingly, Table 2 demonstrates that structural actions provide redistribution only slightly,

¹⁶These 3 structural funds are classified as capital transfers because, unlike all others, they finance fixed capital investments. For details, see Eurostat (2002).

¹⁷Refer to Table 2 for the exact numbers that we discuss in this paragraph.

through the guidance fund. As for revenue component, the bulk of redistribution is carried out via VAT contributions. Finally, the statistical significance of Other Revenues only in the 1992–2001 period suggests a slight redistributive role played by the GNP-related resource, introduced in 1990.

4.3 Allocation effects

To complete the assessment of the economic role of the EU budget, it is important to broaden the analysis from redistribution and stabilization effects to allocation effects, generally recognized as the core element of common EU policies.

Our model allows to investigate this function by looking at the effect of idiosyncratic expenditures and revenues shocks onto idiosyncratic *GNP*, both in the short run (growth rates) and in the long run (log-levels). More importantly, this can be done within the same framework where redistribution and stabilization effects are assessed, thereby ensuring consistency and a stricter control of extraneous variables.

Recalling that we have positive allocation effects when increases in GNP relative growth respond to increases in relative expenditures growth or to falls in relative revenue growth, we find that in the short run, allocation effects for the entire sample are generally weak (figure 1, columns 2 and 3, and Table 3). This scarce overall significance depends, however, on very different (and significant) subperiod effects (fig. 2, 3 and 4). In 1976–85, the impact of total expenditures (more precisely, Δexp) was positive (81%), and that of revenues (Δrev) was negative (+367%); in 1984–93 the effects were both positive, amounting to 86% and -345%. In 1992–2001, however, the figures shift definitely to the negative: -70% for expenditures and a non significant +123% for revenues.

Long run levels of idiosyncratic log-*GNP* are overall affected much more than short run levels; fig. 1 shows that revenues reductions potentially contribute more than rises in expenditures to increases in steady state income (-126% vs 105%). However, the former are not significant, and sub-period estimations help figure out why. In early years the effect of revenues reductions was "perverse", in the sense that it was accompanied by declines in idiosyncratic log-*GNP*, rather than increases. As fig. 2 demonstrates, in 1976–1985 a 1% decrease in revenues yielded a sixfold decline in the idiosyncratic log-*GNP* level, whereas the increase ratio with respect to expenditures was slightly more than 1:1, and hardly significant. The 1984–1993 period, depicted in fig. 3, was the most effective for income boosts: idiosyncratic log-*GNP* rose more than 5 to 1 relative to revenue falls, and more than 3 to 1 relative to expenditure increases. Surprisingly, the last decade (displayed in fig. 4) has witnessed a halting to the income effects of both revenues and expenditures, the latter reverting to -151%. Hence, the behavior of allocation effects seems to be specular to that of stabilization and redistribution: while for the latter the 1984–93 represented a "perverse" period of destabilization and counter-redistribution, for the former

that subperiod recorded the highest effects of net transfers on income.¹⁸

Disaggregating expenditures reveals that only guidance and regional funds among structural operations contribute to income increases (Table 3), together with agricultural funds and external and internal policies. Disaggregating revenues reveals that reductions in VAT contributions lie at the basis of the positive income effect. Sub-period analyses show that for the last decade these impacts have been definitely smaller (considering the huge standard errors, the estimated values are not much different from zero), while a positive contribution of Net Own Resources has emerged.

The effects of EU budget policy on income growth are not permanent in any of the impulse responses. This may suggest either that capital accumulation financed by the EU budget runs rapidly into diminishing returns, or that the size of the budget flows in the aggregate is too small to trigger off significant endogenous growth externalities.

4.4 Additional Results

4.4.1 Convergence

One possible goal of the EU budget — sanctioned in the EU Treaty — is the reduction in income disparities across member countries. Our methodology allows to derive an estimate of the degree of convergence to the average EU *GNP* brought about by EU budget changes. Our allocation estimates show that an increase (drop) in net transfers induces a more than one-to-one rise (fall) of country *log-GNP* relative to the EU aggregate. If such a net transfer flow accrued to (were taken from) countries experiencing a *GNP* fall (rise) relative to average — that is, if it were redistributive — it would drive countries' *GNPs* closer together. And we know from our redistribution analysis that this is indeed the case — namely, that EU budget flows are in fact redistributive. For every unit negative (positive) permanent idiosyncratic *GNP* shock the average country has experienced during the sample period, redistribution has increased (reduced) the country's net transfers by 2.6% (in *GNP* terms); such change has induced in turn a rise (fall) in *GNP* by about $2.6 \cdot 115.5 = 3.0\%$. It follows that approximately 3.0% of any idiosyncratic *GNP* gap has been closed in the long run thanks to EU budget funds. On impact, the effect is much smaller (0.2%). These convergence measures are presented in Table 4.

4.4.2 Substitutability

¹⁸A detailed analysis of this finding would be too far afield for the scope of this paper, but the "anomalous" pattern of EU budget flows in the 1984–93 period is probably related to the first Delors reform of 1987. The Delors package curtailed agricultural funds across the board but increased the flow of benefits especially for those countries — such as Ireland and Portugal — that were experiencing catching-up growth spurts (growth shocks in the period were the largest in the sample). Such increase in structural operations, together with a higher efficiency and a generally expansionary economic environment, fostered in turn an upsurge in output growth.

A traditional interest of the redistribution literature has been the trade-off between redistributive and allocative policies. By looking at both policies in a unified model, we are able to address the issue, albeit on the basis of a limited number of indexes. Examining redistribution vs. allocation measures over the three subperiods of interest, we observe a negative relation, both for revenues and expenditures, and also for budget components. Indeed, we have already pointed out that while the periods 1976–1985 and 1992–2001 have been characterized by a redistributive effort relatively larger than the allocative effort, the opposite holds true for the period 1984–1993.

An analysis of the convergence measure outlined above suggests that the trade-off between allocation and redistribution can be detrimental to convergence: when either redistribution or allocation are negative, the effect is magnified, and convergence halts. But on the other hand, that same trade-off can smooth convergence, when neither is negative, since one is large when the other is small.

4.4.3 Unemployment

We used *GNP* as a measure of standard of living, which is supposedly the criterion redistributive EU net transfers are based upon. However, expenditure decisions are also based on unemployment — for example structural funds for objective 3 are channelled towards regions with higher relative unemployment. Hence, we augmented our benchmark specification to investigate whether any of the budgetary functions to estimate change in relation to this different measure of living standards. Specifically, we added the unemployment rate to our system, and ordered it just before *GNP* or just after *GNP*. The results under output shocks change very little: if anything, the redistribution role of revenues decreases a bit in the system ordering unemployment rate first. Similarly, following positive unemployment rate shocks, expenditures do not respond significantly, while revenues tend to decrease, suggesting that if a country is suffering from a surge in unemployment rate, part of its EU contributions are waived. Overall, these results suggest that stabilization and redistribution functions seem to mostly depend on *GNP* per capita, rather than on the unemployment rate, although the latter seems to matter for revenue-driven redistribution.

5 Conclusions

We have developed a VAR methodology to analyze the dynamics of stabilization, redistribution and allocation of the EU budget. Our application can be fruitfully regarded as the establishment and clarification of many stylized facts on the effects of EU budget flows. The first conclusion is that the overall assessments of these effects over the entire 1976–2001 period are somewhat different from previous studies, but this divergence is partly explained when the sample is broken down by either subperiods or budget components, where quite heterogeneous patterns emerge.

The EU budget stabilizes 2.7% of every shock to member countries' *GNP*, in the two years after the disturbance, mainly through the agricultural fund. Although limited, this amount is significantly different from the null degree established by Sørensen and Yosha (1998) over the 1976–86 range.

Since *GNP* shocks in the EU tend to be permanent, we calculate the redistribution measure: in the long run the budget redistributes 2.6% of changes in country-specific *GNP* (half the effect estimated by de la Fuente and Domenech 2001), mostly due to agricultural expenditures and VAT contributions (and not structural funds, as found in de la Fuente and Domenech 2001). Despite an increasing trend in both stabilization and redistribution, the period 1984–1993 witnessed a "perverse" pattern, with funds accruing to countries whose *GNP* had relatively risen. Some items stand out for their ineffectiveness: the Other Structural Funds (such as Community Initiatives) and the Cohesion Fund play, if anything, some destabilizing and counter-redistributive role. The Other Revenues (*GNP*-related and extra-budgetary) start to provide some redistribution only in the 1992–2001 period, due to the effect of the *GNP*-related resource.

As for the allocation function, the long run "multiplier" of expenditure allocated to EU policies or revenue saved by member countries is 1.66. Many expenditure categories are effective to this purpose, especially EAGGF-Guidance, ERF and external and internal policies. Revenues also play a major role, the positive effects being mainly due to VAT contributions and, more recently, to Net Own Resources. It is interesting to note that 129% of a decrease in the contributions measure is reflected in an income rise in the long run, as opposed to 105% of an expenditure accrual. That is, EU budget expenditures appear to be less efficient than the alternative uses of saved national contributions. This is all the more striking when considering that only a fraction of the reduction in contributions goes to productive investments.

Historically, the 1984–1993 period — problematic for redistribution and stabilization — was instead quite effective for allocation purposes (the long run "multiplier" peaked at 3.06 and 5.39 for expenditures and contributions, respectively). This suggests the existence of a trade-off between equity and efficiency in EU policies, which has had different solutions in different periods.

Our informal analysis of convergence suggests interesting results: 3% of an income gap is closed in the long run through the interplay of EU budget redistribution and allocation.

EU budgetary stabilization and redistribution functions, despite claims to the contrary, do not appear to depend much on unemployment. At most, an increase in the unemployment rate can trigger a tiny reduction in the contribution paid by the member country.

Our results can also shed light on particular issues that have arisen, regarding budget policies. The identification of policies able to provide stabilization without much redistributive effect (guidance funds and internal/external policies) is of interest, in light of recent proposals to amend the Stability and Growth Pact in that direction (e.g. Wyplosz 2005).

A Annex: The Econometric Model

Our purpose is to construct a consistent model that can yield measures of stabilization, of redistribution and of allocation in a unified set-up.

A.1 A metric for stabilization

Consider an EU member economy, and take the identity:

$$y = \frac{y}{(y-r)} \frac{y-r}{(y-r+e)} (y-r+e) \quad (6)$$

where $y \equiv GNP$ is Gross National Product; r is EU budget revenue, the contributions paid by the country to the budget; e is EU budget expenditure, the benefits received by the country from the budget. Note that all variables are in PPP per capita.

By taking logs and differences, reorganizing, and subtracting from the EU aggregate:

$$\Delta y_t^i \equiv \Delta \text{rev}_t^i - \Delta \text{exp}_t^i + \Delta yd_t^i. \quad (7a)$$

where $\Delta y \equiv \Delta \log y - \Delta \log Y$; $\Delta \text{rev} \equiv \Delta \log \frac{y}{y-r} - \Delta \log \frac{Y}{Y-R}$; $\Delta \text{exp} \equiv \Delta \log \frac{y-r+e}{y-r} - \Delta \log \frac{Y-R+E}{Y-R}$; and $\Delta yd \equiv \Delta \log (y-r+e) - \Delta \log (Y-R+E)$. Note that all capital letter variables represent EU aggregates. The four terms in equation (7a) are now country-specific variables (in percent deviation from the EU aggregate). Relation (7a) shows that idiosyncratic GNP growth is identically equal to idiosyncratic disposable income growth, once a measure of the contributions paid to the EU budget is added back in, and of the subsidies received by the EU budget is taken out. Hence, a given idiosyncratic GNP growth is turned into an idiosyncratic disposable income growth by means of revenues and expenditures.¹⁹ If Δy is positive (negative), meaning that the country's income grows faster (slower) than average, then stabilization occurs if Δrev is positive (negative) and Δexp negative (positive), so that the disposable income growth deviation is smaller than the income deviation.²⁰ In order to obtain a

¹⁹We could have arrived at an identity similar to (7a) simply by using the definition of disposable income in differences. However, using logs on each variable provides a better approximation when we consider more than one budget component. In addition, the use of logs allows to work with growth rates, instead of simple differences. Furthermore, it reduces heteroskedasticity in the data.

²⁰The analysis here follows Asdrubali, Sørensen and Yosha (1996) and Asdrubali and Kim (2004), in turn inspired by the argument in Bayoumi and Masson (1995) that the relative income approach is a better measure of stabilization than the elasticity approach. Note that the second term in the RHS of equation (7a) depends not only on e , but also on r . However, since r is subtracted from both numerator and denominator and r in our analysis is far smaller than y , the second term mostly depends on e , given y .

parametric measure of stabilization, we take the derivative of equation (7a) with respect to Δy , obtaining:

$$1 = \beta_R - \beta_E + \beta_U \quad (8)$$

where $\beta_R \equiv \frac{\partial \Delta \text{rev}}{\partial \Delta y}$, $\beta_E \equiv \frac{\partial \Delta \text{exp}}{\partial \Delta y}$, and $\beta_U \equiv \frac{\partial \Delta yd}{\partial \Delta y}$.

β_R , $-\beta_E$, and β_U can be interpreted respectively as the fraction of country-specific *GNP* growth stabilized by EU budget revenues, the fraction stabilized by EU budget expenditure, and the fraction that is not stabilized by EU budget revenue and expenditures. For instance, the measure of stabilization through revenues, β_R , corresponds to:

$$\beta_R = 1 - \frac{d\Delta \log(y - r) - d\Delta \log(Y - R)}{d\Delta \log y - d\Delta \log Y} = 1 - \frac{d(\widehat{y - r})}{d\widehat{y}}. \quad (9)$$

where a hat ($\widehat{}$) indicates a variable in growth deviation from average. If, after an increase in country-specific *GNP* growth ($d\widehat{y}$), the country-specific *GNP* growth net of contributions ($d(\widehat{y - r})$) rises equally, then β_R equals zero, indicating no stabilization; at the other extreme, if *GNP* growth net of contributions does not change, then β_R equals 1, indicating full stabilization; for any intermediate case, there is a one-to-one correspondence between the amount of change in *GNP* growth net of contributions in the face of a unit increase in country-specific *GNP* growth, and the value of β_R . Hence, β_R can be interpreted as a measure of stabilization through budget revenues.

The importance of equation (8) is twofold: first, it neatly decomposes an income growth change into its stabilizing and non-stabilizing effects; this means that the three terms on the RHS are congruent, and we can sum the stabilization via expenditures with the stabilization via revenues, and obtain stabilization via net transfers. Second, being an identity, equation (8) has no omitted variables: a change in income growth must necessarily show up either as stabilized (through Δrev and Δexp) or as not stabilized.

One way to estimate these fractions would be through simple static SUR regressions, along the lines of Sørensen and Yosha (1998):

$$\Delta \text{rev}_t^i = \beta_R \Delta y_t^i + e_t^i \quad (10)$$

$$\Delta \text{exp}_t^i = \beta_E \Delta y_t^i + v_t^i \quad (11)$$

$$\Delta yd_t^i = \beta_U \Delta y_t^i + \zeta_t^i \quad (12)$$

However, such specifications a) do not control for the endogeneity of *GNP*; b) do not partial out the cross effects of the other budget item (for example, a regression of *rev* on *y* can be affected by autonomous changes in *exp*);²¹ c)

²¹One way to address the latter problem — though not the former — would be to run the 3 regressions jointly in a seemingly unrelated system. But to our knowledge, no study of EU budget redistribution has ever adopted such methodology.

are static, in that they do not consider lagged effects. However, as we will see momentarily, alternative estimations are possible for stabilization (as well as for redistribution and allocation) that try to address some of the econometric shortcomings of static regressions.

To implement a metric for stabilization, we devised a method of estimating the coefficients more precisely than with unrelated static simple regressions. To that purpose, we adopted the following structural VAR model:²²

$$\begin{bmatrix} a_{11}^0 & 0 & 0 \\ a_{21}^0 & a_{22}^0 & 0 \\ a_{31}^0 & a_{32}^0 & a_{33}^0 \end{bmatrix} \begin{bmatrix} \Delta y_t^i \\ \Delta rev_t^i \\ \Delta exp_t^i \end{bmatrix} = \sum_{l=1}^p A^l \begin{bmatrix} \Delta y_{t-l}^i \\ \Delta rev_{t-l}^i \\ \Delta exp_{t-l}^i \end{bmatrix} + \begin{bmatrix} \varepsilon_{y,t}^i \\ \varepsilon_{rev,t}^i \\ \varepsilon_{exp,t}^i \end{bmatrix} \quad (13)$$

where A^l is a 3×3 matrix, ε_y is a shock to country-specific *GNP* growth, ε_{exp} is a shock to expenditure growth, and ε_{rev} is a shock to revenue growth. Note that the structural VAR has a recursive structure: shocks to Δy_t^i are assumed to affect the other two variables contemporaneously, and shocks to Δrev_t^i are assumed to affect Δexp_t^i contemporaneously. This is consistent with EU budget rules: each country's contributions and expenditures are determined on the basis of economic activities level, and — due to the balanced-budget rule — expenditure payments are determined after contributions are known.

Although some contemporaneous interactions among variables are restricted, this model is more general than past studies on stabilization. While existing models assume exogenous income and no feedback from EU budget to income, typically using a single equation static specification, our framework allows a lagged feedback from EU budget to income. For example, equation (10) specifies the income process as exogenous, and does not consider any feedback from EU budget variables to income.²³ In addition, they do not partial out the cross effects of the other budget item (for example, a regression of rev on y can be affected by autonomous changes in exp).

By expressing equation (13) in a moving average form,

$$\begin{bmatrix} \Delta y_t^i \\ \Delta rev_t^i \\ \Delta exp_t^i \end{bmatrix} = \sum_{l=0}^{\infty} B^l \begin{bmatrix} \varepsilon_{y,t}^i \\ \varepsilon_{rev,t}^i \\ \varepsilon_{exp,t}^i \end{bmatrix} \quad (14)$$

where B^l is a 3×3 matrix and B^0 is a lower triangular matrix. The moving average representation (or impulse responses) shows how each variable responds to a shock over time; for example, B_{jk}^l (which is the j -th row and k -th column of B^l) shows the effect of the k -th shock on the j -th variable in the system in the l -th period after the shock. From the impulse responses to shocks to country-specific *GNP* growth, $\varepsilon_{y,t}^i$, we can infer the stabilization and — as will become

²²Our preliminary data analysis favors the hypothesis of unit root in the (log of) income process, so we construct a VAR model in a differenced form and recover level relations among the variables via cumulative impulse responses.

²³Also, note that the ordering between Δrev_t^i and Δexp_t^i does not matter when we examine the responses of Δrev_t^i and Δexp_t^i to a shock to Δy_t^i . The ordering only matters when we examine the responses to shocks to Δrev_t^i and Δexp_t^i .

clear below — redistribution role of the EU budget. Note that we can apply the decomposition (8) to the responses to idiosyncratic *GNP* growth shocks since such disturbances would generate exogenous changes in idiosyncratic *GNP* growth in our VAR model; the VAR structure ensures that impact changes in idiosyncratic *GNP* growth are actually due only to idiosyncratic *GNP* growth shocks, rather than, say, lagged expenditure growth changes.

The relative responses of Δexp_t^i and Δrev_t^i to Δy_t^i would show how Δexp_t^i and Δrev_t^i stabilize country-specific income growth in response to shocks to country-specific income growth itself. For each time horizon l , we apply the decomposition as follows:

$$1 = \beta_R^l - \beta_E^l + \beta_U^l, \quad (15)$$

where $\beta_R^l \equiv \frac{\sum_{k=0}^l B_{12}^k}{\sum_{k=0}^l B_{11}^k}$, $\beta_E^l \equiv \frac{\sum_{k=0}^l B_{13}^k}{\sum_{k=0}^l B_{11}^k}$, and $\beta_U^l \equiv \frac{\sum_{i=0}^l (B_{11}^k - B_{12}^k - B_{13}^k)}{\sum_{i=0}^l B_{11}^k}$.

β_R^l , $-\beta_E^l$, and β_U^l can be interpreted as the fraction of country-specific income growth stabilized — or destabilized — by EU budget revenue, that by EU budget expenditure, and the fraction that is not stabilized by EU budget revenue and expenditure, respectively, in the l -th period after the shock. Since stabilization typically focuses on a short-horizon, we use the impact measure ($l = 0$) and the one-year horizon measure ($l = 1$). The impact and the one-year horizon measures show how the country-specific income growth rate is stabilized by EU budget revenues and expenditures *within a year* and *within two years*. Hence our model introduces the dynamics of stabilization which — as it turns out — is quite relevant.

A.2 A metric for redistribution

By taking the measure when l goes to ∞ , we can infer the redistribution role of the budget. The impulse responses cumulated over the very long horizon reveal information on the log-level responses of those variables in the long run, that is, y_t^i , exp_t^i and rev_t^i . The relative response of exp and rev to y would show how exp and rev redistribute income in response to shocks to country-specific *GNP*. That is, for the time horizon $l = \infty$, we apply the decomposition in the following way:

$$1 = \alpha_R - \alpha_E + \alpha_U, \quad (16)$$

where $\alpha_R \equiv \beta_R^\infty$, $\alpha_E \equiv \beta_E^\infty$, and $\alpha_U \equiv \beta_U^\infty$. α_R , $-\alpha_E$, and α_U can be interpreted as the fraction of country-specific log-income redistributed by EU budget revenue, that by EU budget expenditure, and the fraction that is not redistributed by EU budget revenue and expenditure, respectively, in the long run. Note that also in this case we do not restrict the α coefficients, so that we allow our measures to capture negative redistribution.

A.3 A metric for allocation

Within the same framework, the allocation role of the EU budget can be analyzed. As argued in the Introduction, since the goal of public goods provision is an increase in efficiency, a better resource allocation through budget revenues and expenditures must be reflected ultimately in a higher output. Therefore, by examining changes of Δy_t^i relative to Δexp_t^i (or Δrev_t^i) as impulse responses to $\varepsilon_{\text{exp},t}^i$ (or $\varepsilon_{\text{rev},t}^i$), we can infer the short run allocation role of the EU budget. In addition, by examining the long run cumulative responses of these variables, we can infer the long run allocation role of the budget. In essence, the relative responses of Δy_t^i to Δexp_t^i (or Δrev_t^i) show a sort of "multiplier" effect of EU budget expenditures (or revenues). We draw on equation (14) adopting the following measures:

$$\gamma_R^l \equiv \frac{\sum_{k=0}^l B_{21}^k}{\sum_{k=0}^l B_{22}^k} \text{ and } \gamma_E^l \equiv \frac{\sum_{k=0}^l B_{31}^k}{\sum_{k=0}^l B_{33}^k}. \quad (17)$$

Note that, other things being equal (in particular, when the other component of the budget is fixed), a positive allocation role of the revenue would imply that an increase in the revenue (or an increase in *rev*) decreases country-specific output while a positive allocation role of the expenditure would imply that an increase in the expenditure (or an increase in *exp*) increases country-specific output. Therefore, a negative relation between Δy and Δrev and a positive relation between Δy and Δexp imply positive allocation effects.

However, the other component of the budget typically does change. For example, in response to $\varepsilon_{\text{exp},t}^i$, not only does Δexp_t^i , but also Δrev_t^i responds. Therefore, the above measures may reflect the effects on output, not only of changes in the component of interest (for example, expenditure) but also of induced changes in the other component (for example, revenue).

A.4 Breakdown by budget components

We extend our framework to consider the role of each component of revenue or expenditure. To capture the effect of one component of revenue, we can start from a variation on the initial identity:

$$y = \frac{y}{(y - r_m)} \frac{y - r_m}{(y - r)} \frac{y - r}{(y - r + e)} (y - r + e) \quad (18)$$

where r_m is the m -th component of revenue. Then, we estimate a four variable VAR the ordering of which is $y, \text{rev}_m, \text{rev}_a$, and exp where $y \equiv \log y - \log Y$; $\text{rev}_m \equiv -\log \frac{y - r_m}{y} + \log \frac{Y - R_m}{Y}$; $\text{rev}_a \equiv -\log \frac{y - r}{y - r_m} + \log \frac{Y - R}{Y - R_m}$; and $\text{exp} \equiv \log \frac{y - r + e}{y - r} - \log \frac{Y - R + E}{Y - R}$. By proceeding similarly to the basic model, we obtain the following decomposition from the moving average representation (or impulse responses):

$$1 = \beta_{R_m}^l + \beta_{R_a}^l - \beta_E^l + \beta_U^l, \quad (19)$$

where $\beta_{R_m}^l \equiv \frac{\sum_{k=0}^l B_{12}^k}{\sum_{k=0}^l B_{11}^k}$, $\beta_{R_a}^l \equiv \frac{\sum_{k=0}^l B_{13}^k}{\sum_{k=0}^l B_{11}^k}$, $\beta_E^l \equiv \frac{\sum_{k=0}^l B_{14}^k}{\sum_{k=0}^l B_{11}^k}$, $\beta_U^l \equiv \frac{\sum_{k=0}^l (B_{11}^k - B_{12}^k - B_{13}^k - B_{14}^k)}{\sum_{k=0}^l B_{11}^k}$, and B_{1j}^k is the impulse responses of the j -th variable to shocks to y_t^i at time horizon k . From $\beta_{R_m}^l$, we can infer the stabilization role of the m -th component of revenue up to the l -th period after the shock. The redistribution role can be inferred from $\alpha_{R_m} \equiv \beta_{R_m}^\infty = \frac{\sum_{k=0}^\infty B_{12}^k}{\sum_{k=0}^\infty B_{11}^k}$. The allocation role can be also inferred from impulse responses, as discussed in the basic model case.²⁴²⁵ The role of each expenditure item can also be examined in a similar way. For example, starting from

$$y = \frac{y}{(y-r)} \frac{y-r}{(y-r+e_m)} \frac{y-r+e_m}{(y-r+e)} (y-r+e) \quad (20)$$

where e_m is the m -th component of expenditure, we can construct a four-variable VAR model to analyze its effects.

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²⁴The above framework can be extended to consider multi-components of revenue in a system. However, we use the four variable system for various reasons. First, we can treat each component equally; for example, if we include various components in the model, an ordering among components should be assumed, which may be arbitrary. Second, the estimates become less precise by including more variables since we lose degrees of freedom. Third, the nature of shocks may change considerably when we deviate too much from the baseline model, and the results may not be comparable. At any rate, in our applications, the results from the four variable model and the model including more than four variables are not much different for most cases.

²⁵We ordered each component first, then the rest. For instance, we ordered $\Delta \text{rev}_{m,t}^i$ before Δrev_t^i . As discussed in a previous footnote, the ordering does not matter for the stabilization and redistribution measures. However, it may affect the allocation measure. In this regard, we ordered each component as we did for the corresponding totals in the baseline model, namely conditioning revenue components only on current Δy_t^i , and expenditure components only on current Δy_t^i and Δrev_t^i .

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| STABILIZATION | 1976–1985 | | 1984–1993 | | 1992–2001 | | WHOLE | |
|---------------------------|-------------------|-------------------|------------------|------------------|-------------------|-------------------|-------------------|-------------------|
| | 1 year | 2 years | 1 year | 2 years | 1 year | 2 years | 1 year | 2 years |
| EAGGF-Guarantee | -4.4 (2.4) | -5.8 (2.9) | 0.0 | -1.0 (1.3) | -2.2 (1.3) | -4.6 (1.3) | -1.4 (0.8) | -2.6 (1.0) |
| EAGGF-Guidance | -0.7 (0.7) | 0.0 | -0.1 (0.1) | 0.3 (0.2) | -0.5 (0.6) | -0.5 (0.4) | -0.6 (0.2) | -0.2 (0.2) |
| ERDF | -0.4 (0.3) | -0.6 (0.3) | 1.1 (0.3) | 1.8 (0.5) | -2.5 (1.3) | -1.7 (0.8) | 0.0 | 0.2 (0.3) |
| ESF | 0.5 (0.8) | 0.0 | 0.5 (0.3) | 0.5 (0.4) | -0.9 (0.6) | -0.9 (0.5) | 0.2 (0.3) | 0.0 |
| Other Structural Funds | - | - | - | - | -0.3 (0.5) | 0.0 | 0.0 | 0.0 |
| Cohesion | - | - | - | - | 0.0 | 0.0 | 0.1 (0.1) | 0.2 (0.1) |
| Other Expenditures | -1.1 (0.9) | -1.0 (1.0) | 0.8 (0.3) | 0.9 (0.5) | 0.0 | -0.6 (0.7) | -0.2 (0.3) | -0.2 (0.4) |
| Total Expenditures | -6.1 (2.9) | -7.5 (3.1) | 2.4 (1.2) | 2.5 (1.8) | -6.4 (1.5) | -8.3 (1.7) | -1.5 (0.9) | -2.6 (1.2) |
| Net Own Resources | 0.0 | 0.3 (0.3) | 0.0 | -0.1 (0.2) | 0.1 (0.0) | -0.3 (0.3) | 0.1 (0.1) | 0.0 |
| VAT | -0.4 (0.7) | 0.3 (0.4) | 0.0 | 0.3 (0.4) | -0.4 (0.2) | 0.9 (0.7) | 0.0 | 0.1 (0.1) |
| Other Revenues | -0.6 (0.3) | -0.5 (0.3) | 0.0 | -0.1 (0.1) | -0.1 (0.1) | 0.2 (0.3) | -0.1 (0.0) | -0.1 (0.1) |
| Total Revenues | -1.0 (0.7) | 0.0 | 0.0 | 0.0 | -0.4 (0.6) | 0.8 (0.4) | 0.0 | 0.0 |
| Net Transfers | -5.1 (2.6) | -7.5 (2.8) | 2.4 (1.4) | 2.5 (1.7) | -6.0 (1.6) | -9.1 (1.8) | -1.5 (1.0) | -2.6 (1.1) |

Table 1: Stabilization of EU Budget: 1-year and 2-year response of budget item growth to a unit GNP growth increase (percent GNP units). Expenditure and revenue components, as well as net transfers, have been rescaled to match totals. Standard errors are in parenthesis.

| REDISTRIBUTION | 1976–1985 | 1984–1993 | 1992–2001 | WHOLE |
|-------------------------------|-------------------|------------------|--------------------|-------------------|
| EAGGF-Guarantee | -5.0 (3.3) | 0.0 | -4.7 (1.8) | -2.4 (1.2) |
| EAGGF-Guidance | 0.0 | 0.1 (0.1) | -1.0 (0.4) | -0.4 (0.2) |
| ERDF | 0.0 | 1.4 (0.5) | -2.2 (0.8) | 0.2 (0.4) |
| ESF | 1.8 (2.1) | 0.4 (0.3) | -1.9 (0.6) | 0.0 |
| Other Structural Expenditures | - | - | 0.1 (0.3) | 0.1 (0.1) |
| Cohesion | - | - | 0.0 | 0.2 (0.1) |
| Other Expenditures | 0.0 | 1.1 (0.6) | -1.0 (0.7) | 0.0 |
| Total Expenditures | -3.2 (4.2) | 3.0 (1.9) | -10.6 (2.9) | -2.2 (1.4) |
| Net Own Resources | 0.4 (0.6) | -0.1 (0.2) | -0.4 (0.2) | 0.0 |
| VAT | 1.0 (0.7) | 0.4 (0.3) | 0.3 (0.4) | 0.4 (0.3) |
| Other Revenues | -0.2 (0.2) | 0.0 | 0.3 (0.3) | 0.0 |
| Total Revenues | 1.2 (1.1) | 0.3 (0.4) | 0.2 (0.3) | 0.4 (0.3) |
| Net Transfers | -4.4 (3.7) | 2.7 (2.1) | -10.8 (2.8) | -2.6 (1.5) |

Table 2: Redistribution of EU Budget: response of budget item (log-level) to a unit GNP (log-level) change (percent GNP units). Expenditure and revenue components, as well as net transfers, have been rescaled to match totals. Standard errors are in parenthesis.

| ALLOCATION | 1976–1985 | | 1984–1993 | | 1992–2001 | | WHOLE | |
|------------------------|----------------|----------------|----------------|----------------|----------------|-----------------|----------------|----------------|
| | 1 year | LR | 1 year | LR | 1 year | LR | 1 year | LR |
| EAGGF-Guarantee | 87.9 (63.1) | 131.0 (171.0) | 0.0 | 209.3 (256.7) | -127.0 (62.3) | -459.1 (256.1) | 55.4 (48.9) | 106.6 (66.4) |
| EAGGF-Guidance | 586.2 (531.1) | 0.0 | 0.0 | 0.0 | -70.6 (133.8) | -656.5 (913.7) | 222.4 (178.1) | 386.3 (311.8) |
| ERDF | 404.1 (566.6) | 0.0 | 430.0 (234.5) | 1028.4 (539.2) | -58.2 (67.4) | 0.0 | 94.1 (127.3) | 360.8 (214.6) |
| ESF | -817.1 (429.9) | -239.0 (320.0) | 0.0 | 0.0 | -105.0 (100.8) | 0.0 | -255.6 (124.6) | -424.5 (213.9) |
| Other Structural Funds | - | - | - | - | -142.1 (187.9) | 930.7 (1099.9) | 0.0 | 0.0 |
| Cohesion | - | - | - | - | -102.2 (112.3) | -453.5 (664.4) | 0.0 | 0.0 |
| Other Expenditures | 143.9 (154.5) | 663.0 (621.0) | 0.0 | 904.3 (568.4) | 115.1 (92.6) | -418.5 (394.8) | 86.7 (120.9) | 305.8 (169.7) |
| Total Expenditures | 81.0 (60.0) | 111.0 (125.0) | 86.0 (97.0) | 306.0 (168.0) | -70.0 (54.0) | -151.0 (136.0) | 29.0 (41.0) | 105.0 (72.0) |
| Net Own Resources | 305.2 (231.5) | 365.5 (322.4) | -619.9 (873.1) | 0.0 | 199.0 (140.0) | -1607.0 (960.0) | 0.0 | 0.0 |
| VAT | 229.8 (143.4) | 411.3 (307.3) | -415.1 (251.4) | -1617 (1118.9) | 0.0 | 0.0 | -90.0 (139.0) | -378.0 (433.2) |
| Other Revenues | 566.0 (343.9) | 1005.2 (791.4) | 0.0 | 0.0 | 568.0 (473.0) | 1607.0 (1504.0) | 90.0 (120.0) | 0.0 |
| Total Revenues | 367.0 (199.0) | 594.0 (441.0) | -345.0 (240.0) | -539.0 (476.0) | 123.0 (152.0) | 0.0 | 0.0 | -126.0 (241.0) |
| Net Transfers | -143.0 (110.4) | -241.5 (234.2) | 215.5 (240.8) | 422.5 (227.4) | -96.5 (68.1) | -75.5 (77.3) | 14.5 (21.2) | 115.5 (77.1) |

Table 3: Allocation of EU Budget: percent response of GNP log-level to a unit log-level budget item increase (GNP units). Expenditure and revenue components, as well as net transfers, have been rescaled to match totals. Standard errors are in parenthesis. Positive responses to expenditures and net transfers, as well as negative responses to revenues, indicate a positive allocation effect.

| CONVERGENCE | 1976–1985 | | 1984–1993 | | 1992–2001 | | WHOLE | |
|---------------------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|
| | SR | LR | SR | LR | SR | LR | SR | LR |
| EAGGF-Guarantee | -3.9 | -6.6 | 0.0 | 0.0 | 2.8 | 21.6 | -0.8 | -2.6 |
| EAGGF-Guidance | -4.1 | 0.0 | 0.0 | 0.0 | 0.4 | 6.6 | -1.3 | -1.5 |
| ERDF | -1.6 | 0.0 | 4.7 | 14.4 | 1.5 | 0.0 | 0.0 | 0.7 |
| ESF | -4.1 | -4.3 | 0.0 | 0.0 | 0.9 | 0.0 | -0.5 | 0.0 |
| Other Structural Funds | - | - | - | - | 0.4 | 0.9 | 0.0 | 0.0 |
| Cohesion | - | - | - | - | 0.0 | 0.0 | 0.0 | 0.0 |
| Other Expenditures | 0.0 | 0.0 | 0.0 | 9.9 | 0.0 | 4.2 | -0.2 | 0.0 |
| Total Expenditures | -4.9 | -3.6 | 2.1 | 9.2 | 4.5 | 16.0 | -0.4 | -2.3 |
| Net Own Resources | 0.0 | 1.5 | 0.0 | 0.0 | -0.2 | 6.4 | 0.0 | 0.0 |
| VAT | -0.9 | 4.1 | 0.0 | -6.1 | 0.0 | 0.0 | 0.0 | -1.5 |
| Other Revenues | -3.4 | -2.0 | 0.0 | 0.0 | -0.6 | 4.8 | -0.1 | 0.0 |
| Total Revenues | -3.7 | 7.1 | 0.0 | -1.6 | -0.5 | 0.0 | 0.0 | -0.5 |
| Net Transfers | 7.3 | 10.6 | 5.2 | 11.4 | 5.8 | 8.2 | -0.2 | -3.0 |

Table 4: Convergence through the EU Budget: short-run and long-run allocation effect of stabilization-induced or redistribution-induced budget item change following a percent unit increase in GNP (percent GNP units). SR figures are the product of the corresponding estimates in Table 1, "1-year" column times Table 3, "1-year" column; LR figures are the product of the corresponding estimates of Table 2 times Table 3, "LR" column. Negative figures indicate convergence, positive figures divergence.)

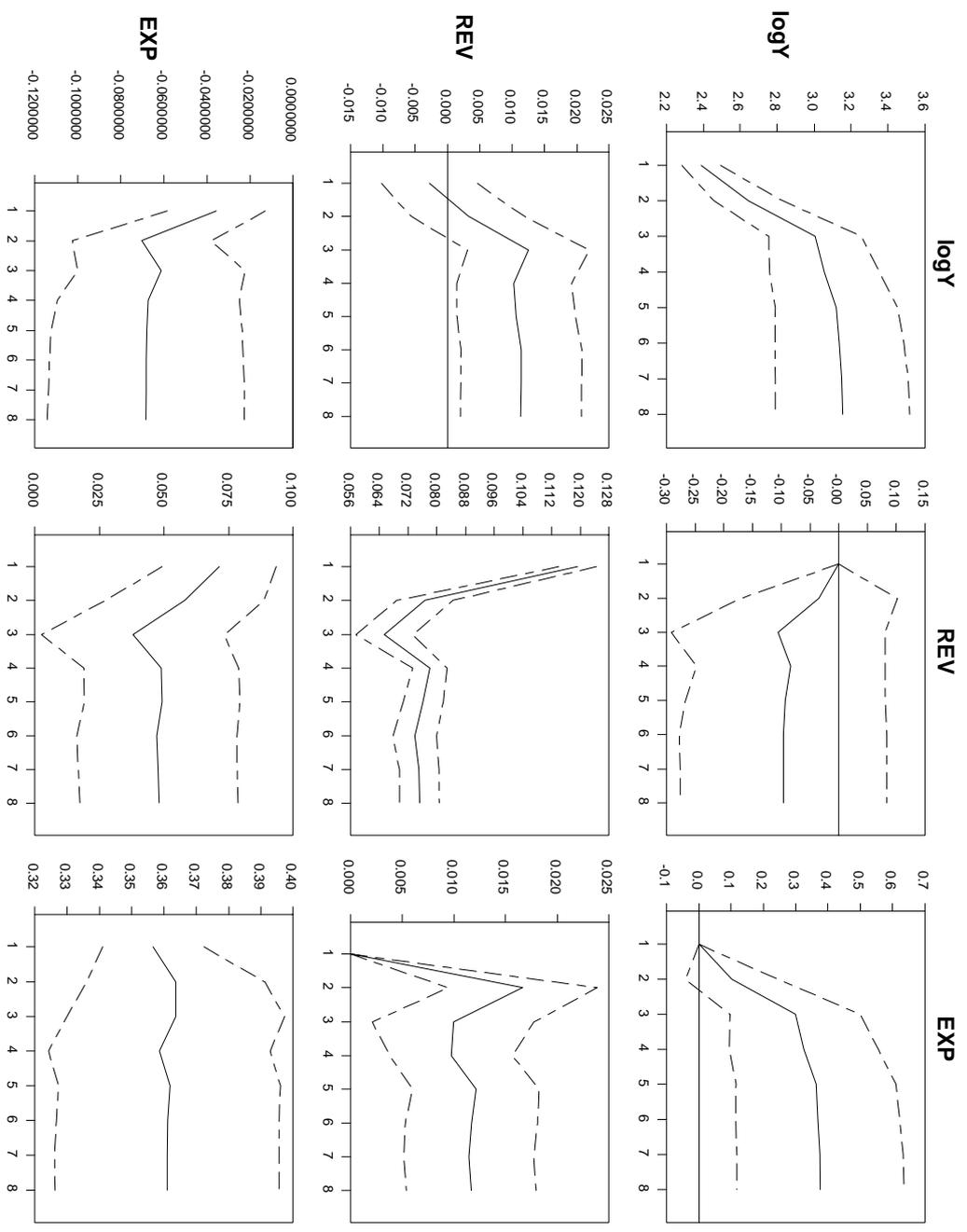


Figure 1: Impulse responses - whole sample

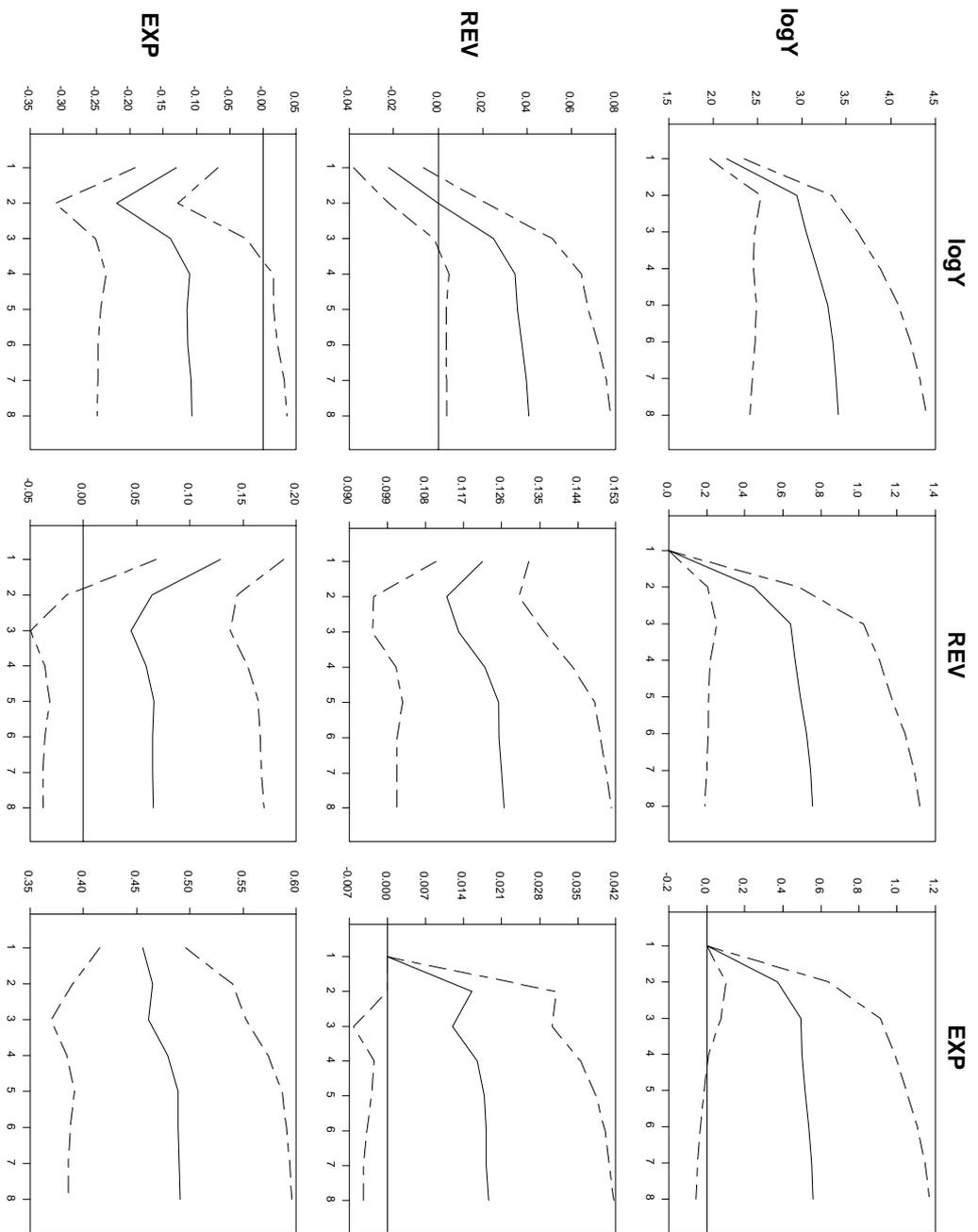


Figure 2: Impulse responses - 1976-1985 subsample

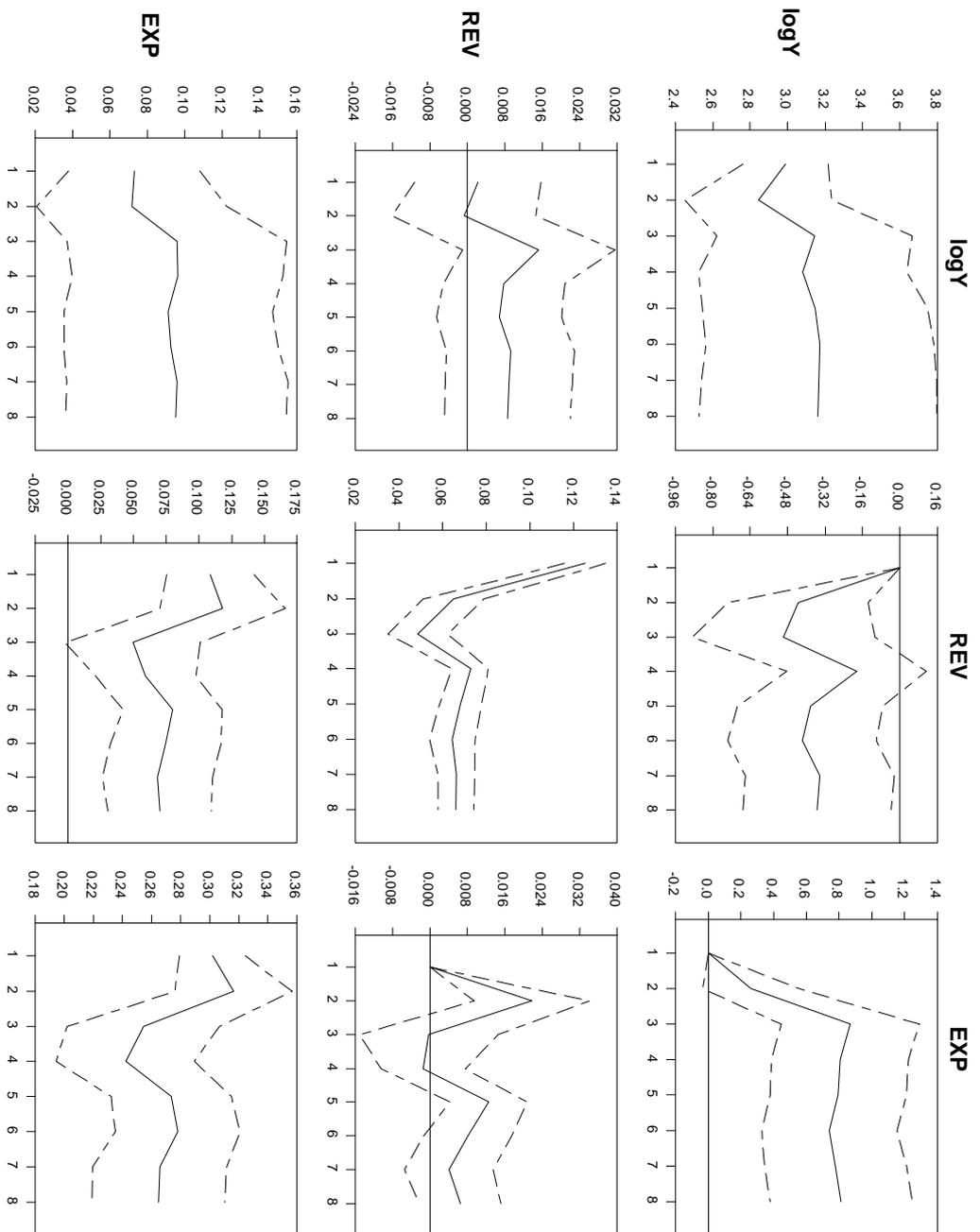


Figure 3: Impulse responses - 1984-1993 subsample

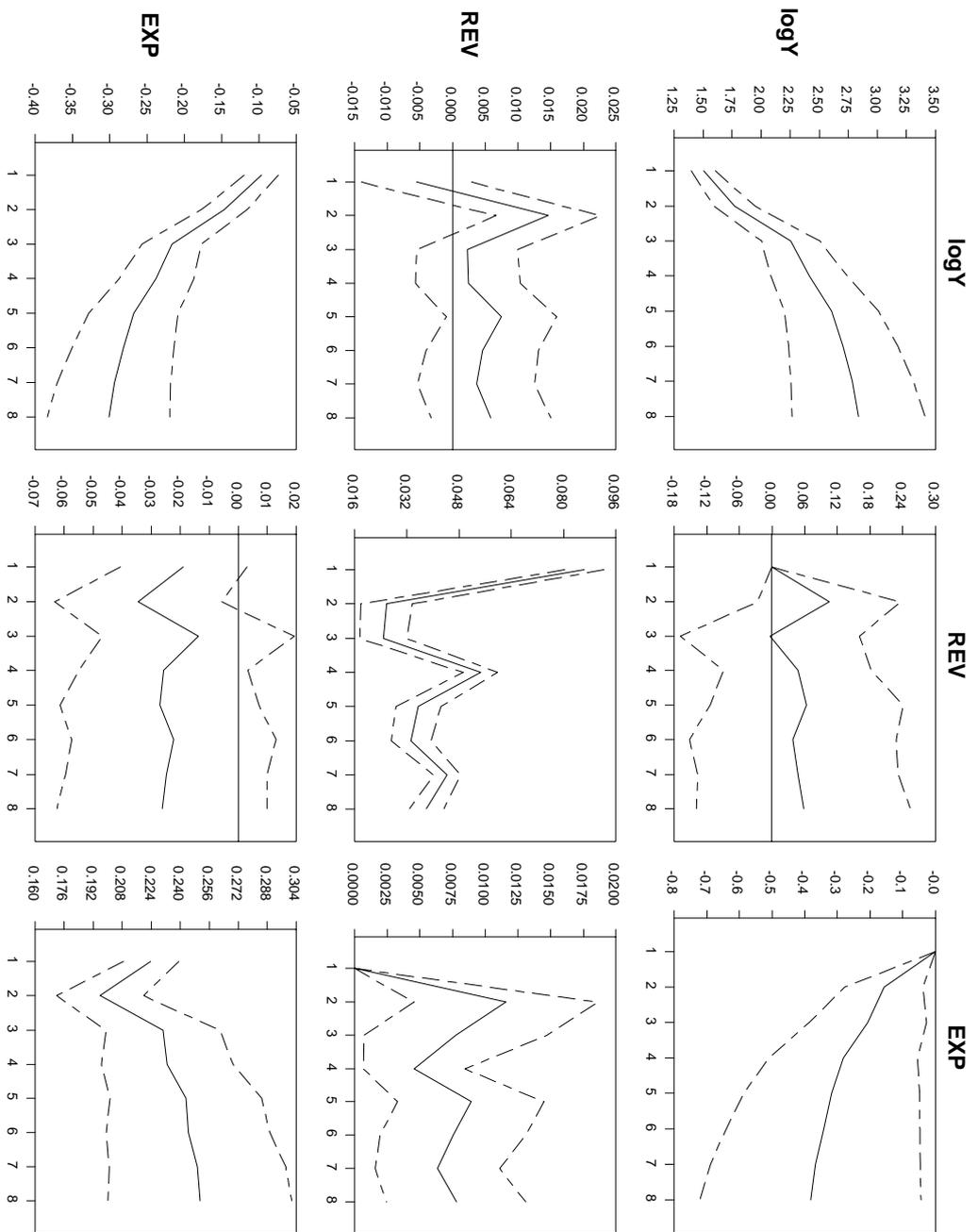


Figure 4: Impulse responses - 1992-2001 subsample