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DISCUSSION PAPER

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ABSTRACT

The VAR/SVAR (Vector Autoregressive and Structural Vector Autoregressive) models are the cornerstone of the contemporaneous empirical macroeconomic research, in particular for being able to measure the impact of fiscal policy shocks. They may be employed as atheoretical models, as well as a mean to support the estimation and testing of DSGE (Dynamic Stochastic General Equilibrium) models – the main theoretical tool for modern macroeconomics. Nevertheless, VAR models may be subject to pathologies, such as the non-fundamentalness. It is capable of biasing the estimates in any direction or intensity, and it consists of the non-invertibility of the MA (Moving Average) representation on the positive powers of the lag operator. This is associated with the insufficiency of the econometrician's data to estimate the model's correct parameters or with model misspecification. This study is the first to employ the latest and most efficient tests for non-fundamentalness on fiscal data for the USA: the Forni and Gambetti's (2014) and Canova and Sahneh (2018) tests. The data and model were found to be non-fundamental.

Keywords: fiscal policy; VAR; macroeconometrics; fundamentalness.

1 INTRODUCTION

The aim of this paper is to verify if the solution presented by Leeper et al. (2011), to the non-fundamentalness problem they found in Blanchard and Perotti's (2002) fiscal VAR (Vector Auto Regression) model and data, has indeed allowed them to arrive at a model with a fundamental representation.

In order to achieve this goal, this research employed the Forni and Gambetti's (2014) and the Canova and Sahneh's (2018) tests for fundamentalness.

Blanchard and Perotti's (2002) paper (BP) was a seminal contribution, virtually initiating the Fiscal VAR literature in the USA. That was the first time the timing of fiscal policies and fiscal revenue responses was considered in the identification of a fiscal SVAR (Structural Vector Auto Regression) model.

Nevertheless, Leeper et al. (2011) concluded that BP's model and data are non-fundamental, so their results are not trustworthy. They employed an additional variable to avoid the missing information presented in the data set and therefore concluded that they corrected the model and data for non-fundamentalness, in what they claimed was a successful attempt.

The VAR/SVAR models are the cornerstone of the contemporaneous empirical macroeconomic research, in particular for measuring the impact of fiscal policy shocks. They may be employed as atheoretical models, as well as a mean to support the estimation and testing of DSGE (Dynamic Stochastic General Equilibrium) models – the main theoretical tool for modern macroeconomics.

Nevertheless, VAR models may be subject to econometric pathologies, such as non-causality and non-fundamentalness. They are capable of biasing the estimates in any direction or intensity. The presence of non-fundamentalness is related to the existence of explosive roots in the autoregressive polynomials of stationary processes and both refer to the insufficiency of the econometrician's data to estimate the model's correct parameters.[1] The latter is closely associated with the former, and it consists of the

1. See Sahneh (2015b).

non-invertibility of the MA (Moving Average) representation in positive powers of the lag operator, in covariance-stationary processes. Strictly in the case of covariance stationary series, both non-causality and non-fundamentalness are equivalent concepts.[2]

As mentioned before, the goal of this paper is to employ more recent fundamentalness tests to check these conclusions.

A VAR model is considered fundamental if there is only one MA (Moving Average) representation of the model; therefore, the MA representation is invertible in positive powers of the lag operators. A non-fundamental VAR does not fulfill this invertibility requirement, thus there are more than one MA representation of the VAR. This implies the estimated coefficients are subject to biases of any size and direction.

The non-fundamentalness problem may occur because of misspecification, including missing information. The Leeper et al. (2011) proposed solution for BP's data is the addition of a variable the authors believed was missing, so that the model missing information is resolved and this should solve the non -fundamentalness problem found in BP's application. The problem is that they test that hypothesis through a necessary conditions test, which is overpowered by the more complete sufficient condition test proposed by Forni and Gambetti (2014) and later by Canova and Sahneh (2018).

In the next section, the non-fundamentalness problem is described. The third section presents the Forni and Gambetti (2014) and the Canova and Sahneh (2018) tests. The fourth shows the results and the last contains the conclusions and the final remarks.

2 THE PROBLEM OF NON-FUNDAMENTALNESS

Kilian and Lütkepohl (2017) presented the following definition of non-fundamentalness, with some minor textual modifications.

The classic definition of a VAR model, as a proxy for the data generation process is:

2. See Lanne and Saikkonen (2013).

$$\Theta(L)x_t = u_t \tag{1}$$

Where u_t is the one step ahead prediction error, based on lagged information $\{x_{t-1}, x_{t-2}, \dots\}$, and $\Theta(L) = \Phi(L)^{-1}$, obtained from a linear VAR model.

One of moving average representations of the VAR is denominated the fundamental representation. The fundamental VAR(p) must, therefore, have a K-dimensional representation of the x_t process as shown below:

$$x_t = \Phi(L)u_t \tag{2}$$

Where $t \in \mathbb{Z}$. A fundamental VAR must have only a single MA representation like equation (2). Nevertheless, it is conceivable that the shocks from the MA representation do not coincide with the prediction errors estimated by a given VAR model. Thus, the MA representation may be:

$$x_t = \Phi^*(L){u_t}^* \tag{3}$$

Where ${u_t}^*$ is not the linear prediction error based on $\{x_{t-1}, x_{t-2}, \dots\}$. Therefore, there may be two different MA representations for the same data series that are observationally equivalent and it is impossible to recover the shocks of one representation through the other one in a Gaussian process, since the first and second order moments of the process are the same for both representations.

Thus, it is not feasible to obtain the u_t prediction errors from the $\Phi^*(L)$ coefficients. As the impulse-response functions rely on the MA representations, the non-fundamental coefficients may possibly generate considerably different impulse response functions from the ones related to the data generating process (DGP).

The information contained in u_t and in ${u_t}^*$ are different, so that it is possible to think of non-fundamentalness as a missing information bias. It may occur because the econometritian does not observe all the relevant information necessary to recover the correct DGP. It is usual to associate that missing information to unobservable economic agents' expectations, when we consider a macroeconomic model.

A VAR model and data as a whole is non-fundamental when it has more than one MA representation. This is strongly associated to the non-invertibility in positive powers of the lag operators of the MA representation of the model. When considering covariance stationary variables, the two concepts are exactly equivalent.

Consider the equation (2) formulation where $u_t \sim (0, \Sigma_u)$ is a *M*-dimensional white noise with zero mean and a homoscedastic nonsingular covariance matrix Σ_u, with uncorrelated errors. It is also possible that the dimension of the white noise e_t is different from that of the x_t process. Consider the operator below, which is a K × M power series matrix, potentially of an infinite order on the lag operator, with absolutely summable coefficient matrixes Φ_i that admit VAR and VARMA representations:

$$\Phi(L) = \sum_{i=0}^{\infty} \Phi_i \, L^i \qquad (4)$$

Let $\mathcal{L}^2(\Omega, \mathcal{F}, \mathbb{P})$ be the Hilbert Space based on the probability space $(\Omega, \mathcal{F}, \mathbb{P})$, where Ω is the sample space, $\mathcal{F}$ is the sigma-algebra and $\mathbb{P}$ is the probability measure. Assume all relevant variables are contained in that space. Assume also that $\mathcal{H}_t^x$ is the subspace of $\mathcal{L}^2(\Omega, \mathcal{F}, \mathbb{P})$ generated by $\{x_{t-1}, x_{t-2}, \dots\}$ and that $\mathcal{H}_t^u$ is the subspace of $\mathcal{L}^2(\Omega, \mathcal{F}, \mathbb{P})$ spanned by $\{u_{t-1}, u_{t-2}, \dots\}$, so that if u_t is the one step ahead prediction error from the optimal linear prediction model, then:

Definition 1: The process u_t is x_t-fundamental if $\mathcal{H}_t^x = \mathcal{H}_t^u \ \forall t \in \mathbb{Z}$. The process is non-fundamental if $\mathcal{H}_t^x \subset \mathcal{H}_t^u \ \wedge \mathcal{H}_t^x \neq \mathcal{H}_t^u$ for some $t \in \mathbb{Z}$.

According to Lütkepohl (2014, p. 577): "The MA representation is fundamental if u_t is the one-step ahead prediction error associated with the optimal linear prediction of x_t based on lagged x_t".

Let *M* be the dimension of the white noise process u_t and *K* the dimension of the stationary stochastic process x_t, Forni et al. (2009) observed that for $M \leq K$, defined as a Rectangular System, u_t is x_t-fundamental if rank $\Phi(z) = M$. For $M = K$, called a Square System, if all roots of det $\Phi(z)$ are outside the complex unit circle, (2) is a fundamental representation that can be inverted to obtain a VAR representation, possibly of infinite order.

There is also an alternative definition of fundamentalness that explores the concept of different information sets, mentioned above, which is obtained from Alessi, Barigozzi e Capasso (2008), transcripted below.

Definition 2: (Fundamentalness in Square Systems): Given a covariance stationary process x_t, the representation $x_t = \Phi(L)u_t$ is fundamental if:

1. u_t is a white noise vector;
2. $\Phi(L)$ has no poles inside the unit circle;
3. Det $\Phi(z)$ has all its roots out of the unit circle $\leftrightarrow \det \Phi(z) \neq 0, \forall z \in \mathbb{C}; |z|<1$.

Therefore, a Square System VAR is fundamental if the relevant MA representation has a polynomial with positive powers on its lag operator and is invertible. A non-fundamental representation has a MA representation depending on future shocks, thus the analogy to expectations, which are not observable and may exert an impact on variables of interest.

The methods to deal with non-fundamentalness include the addition of the missing information through new variables or the employment of models that allow for the occurrence of non-invertible MA components, like the Non-causal VAR proposed by Lanne and Saikkonen (2013).

Lütkepohl (2014) stresses, though, that the use of common factors or Bayesian techniques to expand the information set may not be sufficient to deal with the problem. The author recommends the use of handpicked variables, as done by Leeper, Walker and Yang (2013) and Kilian and Murphy (2014). Leeper, Walker and Yang (LWY) tested the original models and data for Blanchard and Perotti's (2002) model and data, as well as for Moutford and Uhlig's (2009). Both were found to be non-fundamental, but LWY claim they have solved the non-fundamentalness problem in BP's model and data by adding an additional variable that supposedly corrected the information insufficiency. The variable in question is a spread between state and federal bonds that have different taxation rules, thus revealing the fiscal foresight information not included in the previous datasets.

3 METHODOLOGY: NON-FUNDAMENTALNESS TESTS

In this paper, the two foremost tests for fundamentalness are employed in order to test for the occurrence of non-fundamentalness in BP's (1002) model and data. As the non-fundamentalness appears in the reduced form VAR, it is not necessary to test the full SVAR model, as the identification is not likely to be capable of correcting possibly biased previously estimated coefficients.

3.1 The Forni and Gambetti Test

This sub-session describes the Forni and Gambetti (2014) test, henceforth FG Test, as described in Forni, Gambetti and Sala (2018). The strategy of the test is to detect if there is fundamentalness by checking if a set of macroeconomic variables summarized in common factors Granger cause the VAR variables. In order to do so, it is necessary to construct a second large set of macroeconomic variables and estimate its common factors.

Then, consider the impulse-response function representation:

$$x_t = \Pi(L)u_t \tag{5}$$

Where x_t is an *n*-dimensional vector of macroeconomic variables; $\Pi(L)$ is an $n \times q$ matrix of rational Impulse-Response Functions and u_t is a *q*-dimensional vector of structural shocks, assumed to be serially uncorrelated and mutually orthogonal at all lags and leads.

As stated in Definition (2), this representation is fundamental if u_t lies in the information space spanned by present and past x_t. In that case, and u_t deliver the exact same information. If the history of x_t until time *t* does not contain all the information necessary to recover u_t, the representation is non-fundamental, so the shocks contain more information than the past x_t.

The referred vector of macroeconomic variables that are not included in the VAR $y_t = (y_{1,t} \dots y_{N,t})'$ which are also driven by the structural shocks u_t and, possibly, also by idiosyncratic measurement shocks $\varepsilon_t = (\varepsilon_{1,t} \dots \varepsilon_{N,t})'$ is represented by:

$$y_t = \vartheta(L)u_t + \varepsilon_t \tag{6}$$

By using the variables in y_t it is possible to get independent information on ε_t. That information can be extracted, as mentioned, by taking the principal components of y_t. Let $f_t = (f_{1,t} \dots f_{s,t})'$ be such principal components, which are consistent estimators of the common factors (Stock and Watson, 2002), and the factors deliver the same information as the shocks (Forni et al., 2009).

Since f_t contains information on the shocks, it can help predicting x_t, but it will only happen in the non-fundamentalness case, since in the fundamental case x_t already has all the information provided by the shocks. So, if f_t Granger-cause x_t, then there is non-fundamentalness (Forni, Gambetti and Sala, 2018, p. 4).

Therefore, the test procedure consists on computing the f_t's from the y_t auxiliary data and then estimating the regression below:

$$x_t = \mu + \sum_{j=1}^{p_1} \alpha_j x_{t-j} + \sum_{j=1}^{p_2} \beta_j f_{t-j} + v_t \tag{7}$$

The next step is to test if the β_j coefficients are zero, through an F-Test.

3.2 The Canova and Sahneh Test

Canova and Sahneh (2018) considered that the FG Test has bad properties mainly concerning the aggregation of variables.

Canova and Sahneh argue that the Granger causality test employed in the FG test is inadequate for testing for fundamentalness due to what they call the "curse of dimensionality". This comes from the fact that studies with few variables may have few primary sources of shocks, which may disturb the economy, so that the estimated shocks are a linear combination of the original primitive shocks. Therefore, some VAR variables may be predicted by other variables that contain information on those primitive shocks and this has nothing to do with the fundamentalness of the model. This, of course, is thought to be valid in aggregate variables as well, therefore causing what the authors define as "spurious non-fundamentalness".

They propose a new model to solve this issue, called the CH Test. The main idea is that if the model is non-fundamental, future shocks can predict an auxiliary vector of macroeconomic variables that are excluded from the VAR. Later, Forni, Gambetti and Sala (2018) rebuffed those considerations, arguing in favor of the FG test.

The CH Test, as described in Canova and Sahneh (2018), implies two steps. First, it requires computing the *s* principal components vector from the auxiliary variables $f_t = (f_{1,t}, \dots, f_{s,t})'$ and then to estimate the VAR below:

$$x_t = \lambda + \sum_{j=1}^{r} \rho_j \, x_{t-j} + u_t \tag{8}$$

The second step is to take the residual u_t from the regression below:

$$f_t = \gamma + \sum_{j=1}^{p_3} \varphi_j f_{t-j} + \sum_{j=1}^{p_4} \eta_j u_{t-j} + \sum_{j=1}^{p_5} \psi_j u_{t+j} + e_t \tag{9}$$

The final step is to test if the ψ_j are different from zero, through a usual F-Test.

According to Forni, Gambetti and Sala (2018), the regression (9) is a version of the Sims (1972) test, proposed by Geweke, Meese and Dent (1983) apud Forni, Gambetti and Sala (2018), the only difference being that the variables are pre-whitened. Forni, Gambetti and Sala (2018) claim that both models are asymptotically equivalent, their results may differ in small samples.

4 DATASET AND RESULTS

As already mentioned, Leeper et al. (2011) tested Blanchard and Perotti (2002) (BP) model and data for fundamentalness using a test for necessary (but not sufficient) conditions for the presence of fundamentalness. According to the test, they found BP data and model to be non-fundamental. As a solution, they included a variable to provide the model with the missing information, in order to make the model fundamental. Their test indicated the efforts were successful. The variable that supposedly provided the missing information was a spread between municipal and state bonds and comparable federal ones. The local bonds are not subject to federal income taxes, so the announcement of changes in federal taxes should affect the spread between those bonds. Then, that spread supposedly includes the information on news from the fiscal authorities that are observable by the agents, but not to the econometricians. This is a typical case where the inclusion of a handpicked variable could supply the missing information and "fix" the model (Kilian and Lütkepohl, 2017).

In this paper, these results are going to be checked through the FG and CH Tests. Therefore, BP's original data was downloaded from Prof. Blanchard online homepage[3] and Prof. Todd Walker kindly supplied their original spread variables.

Considering the original BP data, the net taxes variable is precisely as defined in BP: the sum "Personal Tax and Nontax Receipts; Corporate Profits Tax Receipts; Indirect Business Tax and Nontax Accruals and Contributions for Social Insurance, less Net Transfer Payments to Persons and Net Interest Paid by Government" (Blanchard and Perotti, 2002, p. 1336).

The public expenditures are defined as "Purchases of Goods and Services, both current and capital" (Blanchard and Perotti, 2002, p. 1336). The data sources are the Quarterly National Income and Product Accounts, except the corporate profits receipts, from the Quarterly Treasury Bulletin. All items refer to the general government, which is the sum of local and federal governments. All data are in real, per capita terms and was seasonally adjusted by ARIMA X13.[4]

3. Available at: <https://economics.mit.edu/faculty/blanchar/papers>.
4. BP do not mention where the GDP data was from, but we suppose it comes from the FRED Database.

The spread variable was built from two distinct components. The first is the return on tax-free municipal bonds, supplied by Salomon Brothers' Analytical Record of Yields e Yield Spreads, from 1954 and 1994, and from the return on AAA municipal bonds from Bloomberg's Municipal Fair Market Bond Index, from 1994 onwards.

The second component is the return on the 5-year constant maturity Federal Bonds (non- indexed by inflation). The data is from Federal Reserve's Statistical Release on Selected Interest Rates, and Leeper et al. (2011) took the quarterly average from the monthly data to transform them into quarterly data, like the rest of the sample. Those data come in two variants: the 1-year maturity spread and the 5-year maturity spread.

In the present study, we tested three datasets. The first includes the original BP data only. The second incorporates the 1-year spread and the last incorporates only the 5-year spread.

It is relevant to note that testing for fundamentalness requires only the reduced form VAR, so the estimated elasticities, used for the structural form identification, are unnecessary.

It was crucial to differentiate some of the BP data, as fundamentalness tests work only with stationary data. The GDP and the net taxation variables were found to be I(1), and had to be differentiated. The government expenditure was found to be stationary.

Both tests, though, require the employment of an additional dataset, in order to obtain the principal components used in both the FG and CH tests. This dataset includes the logarithms of: Producer Price Index by Commodity for Stage of Processing: Crude Materials; Total Reserve Balances Maintained with Federal Reserve Banks; Private Nonresidential Fixed Investment; Real Market Value of Gross Federal Debt; Inflation: Consumer Price Index: All Items; Spot Crude Oil Price: West Texas Intermediate (WTI), Dollars per Barrel, Quarterly, Not Seasonally Adjusted, all from the FRED Database and the Dow Jones Industrial Average Index, obtained in the Ipeadata Database.[5]

5. Ipeadata is a Brazilian data portal, owned by the Ministry of the Economy. Available at: <www.ipeadata.gov.br>.

The database also includes the first difference of the log of the real[6] × dollar exchange rate and the dollar exchange rates against the Yuan, British Sterling; the Japanese Yen and the Canadian Dollar. We also built a simple index of four European currencies: the German Mark; the Italian Lira; the French Franc and the Spanish Peseta. The index is a weighted average of them, as within the sample they were first mostly free floating and later coordinated into the "European Serpent". Data is from the FRED Database, except for the British Pound, from IFS/IMF. In addition to that, the auxiliary database includes the basic interest rates from the Central Banks from Germany and the Netherlands, as well as the first difference from those rates from the French and the UK's Central Banks, as they were nonstationary. All that data is from IMF/IFS, retrieved from the Ipeadata database.

It is very important to stress that the goal of the auxiliary dataset principal components is not to provide a reliable estimation of the impacts of variables, but to check if there is any correlation between some of the data not included in the VAR and the main dataset. Therefore, little attention was given to the estimation of the optimal number of principal components.

4.1 The CH Test Results

The Table 1 registers the results of the CH Test for different quantities of principal components. The columns show the P-Values of the F-tests for the null hypothesis of fundamentalness.

The column A shows the P-values when the three original Blanchard and Perotti's variables are in the main VAR dataset and the 19 previously described variables are in the auxiliary dataset, from which the up to seven principal components were estimated. All but one P-value is significant at the 5% level, leading to the rejection of fundamentalness. That divergent P-value refers to three principal components, and it is significant at the 10% level. Therefore, the test rejects fundamentalness in the original BP dataset, corroborating Leeper et al. (2011).

6. Deflated by the US' GDP Deflator.

If the Leeper et al. (2011) solution is valid, then the inclusion of the supposedly relevant missing information in the main dataset should therefore eliminate the detected non-fundamentalness problem, as Leeper et al. (2011) claimed that the spreads from municipal and state bonds to the Treasury Bills contains that information, thus should “fix” the problem. Nevertheless, the results from column B show that it is not the case. Although for some numbers of principal components the P-values do not reject fundamentalness, the use of two, five, six and seven principal components do. As the test is aimed at testing for some influence of omitted variables, it is possible to conclude for the rejection of the null hypothesis, thus rejecting the Leeper et al. (2011) solution, as far as the 1-year spread is concerned.

TABLE 1

CH Test Results from US data between the 2nd quarter of 1962 and the 4th quarter of 1997, as the P-values of F-Tests for the null hypothesis of fundamentalness, according to the selected number of principal components from the auxiliary data (test for two periods ahead)

Number of principal components	P-values (no *spread* on both sets) (A)	P-values with 1-year *spread* on the main dataset (B)	P-values with 5-year *spread* on the main dataset (C)
1	0.003314112	0.742547800	0.956074800
2	0.005935725	0.032589230	0.001834909
3	0.050978710	0.050395940	0.001583760
4	0.030459890	0.102866200	0.009510506
5	0.014554160	0.023013450	0.007246542
6	0.004176823	0.006407723	0.003685173
7	0.005014976	0.006569689	0.002888861

Authors’ elaboration.

Column C reports the results for the 5-year spreads. In that case, all but one number of principal components reject the null hypothesis.

Therefore, the CH test rejects fundamentalness in all formulations, and rejects the Leeper et al. (2011) solution for the non-fundamentalness found in BP’s dataset.

4.2 The FG Test Results

The Forni and Gambetti test includes the same variables as the CH Test, as already discussed, as both share the same principles. Table 2 presents the results of the FG test using the aforementioned datasets.

The FG Test results are quite similar to those from the CH Test. Column A presents the P-Values from the test for the very same main and auxiliary databases as the Column A from table 1, therefore testing the original BP database. All but two quantities of principal components the FG Test rejects the null hypothesis of fundamentalness at 5% of significance, like the CH Test. Similarly, in columns B and C, the inclusion of the 1-year and the 5-year spread also present non-fundamentalness, according to the FG Test. In all quantities of principal components but one, with either spread, the test also rejects fundamentalness, this time at the 1% level of significance.

TABLE 2
FG Test Results from US data between the 2nd quarter of 1962 and the 4th quarter of 1997, as the P-values of F-Tests for the null hypothesis of fundamentalness, according to the selected number of principal components from the auxiliary data (test for two periods ahead)

Number of principal components	P-values (no *spread* on both sets) (A)	P-values with 1-year *spread* on the main dataset (B)	P-values with 5-year *spread* on the main dataset (C)
1	0.3600	0.4140	0.7100
2	0.0040	0.0040	0.0040
3	0.0140	0.0040	0.0020
4	0.0920	0.0060	0.0100
5	0.0420	0.0040	0.0020
6	0.0000	0.0000	0.0000
7	0.0000	0.0000	0.0000

Authors' elaboration.

5 CONCLUSION

Leeper et al. (2011) tested the seminal model and data from Blanchard and Perotti (2002) for non-fundamentalness through a necessary conditions based test for non-fundamentalness. They concluded that the model and data are non-fundamental and proposed a solution based on the inclusion of the spread from tax-exempt state and local bonds to comparable Treasury Bonds on the dataset. According to their test, that spread provides the system with the necessary information to correct for non-fundamentalness.

Forni and Gambetti (2014) and Canova and Sahneh (2018) tests are the most recent sufficiency tests for fundamentalness and so we performed those tests on the same Blanchard and Perotti's (2002) data. The results from both tests corroborated Canova and Sahneh (2018) conclusion that BP data is non-fundamental.

Nevertheless, both tests rejected fundamentalness in BP data even when the Leeper et al. (2011) spreads were included in the main dataset. This leads to the conclusion that the spread variable did not solve the data insufficiency problem and, therefore, did not solve the non-fundamentalness problem as described in Leeper et al. (2011).

This suggests it may be much more difficult than previously thought to solve non-fundamentalness with handpicked variables that supposedly contain the missing information in those systems, as proposed by Kilian and Lütkepohl (2017).

Due to the nature of the non-fundamentalness problem, which may generate biases of any size and direction on the estimates, this conclusion is disturbing. Even though the rejection of a single case of the employment of this type of solution is not at all a definitive denial of the method of finding variables that contain the missing data, such applications are, up to this date, pretty rare and the prospect of the failure of one such rare application is discouraging.

It is very important to search for and pursue alternative ways to solve this econometric pathology, in order to ensure that macroeconometric models based on VAR and SVAR models produce useful estimates of the response of variables to structural innovations.

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