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Trade openness, growth, and informality: Panel VAR evidence from OECD economies

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Abstract

This paper analyzes empirically the linkages between trade openness, economic growth, and the size of the informal economy. I employ panel VAR techniques in a quarterly panel data set composed of 12 advanced economies over the period from 1964:1 to 2010:4 allowing bi-directional interaction between the variables in the system in order to address the endogeneity problem. The results provide evidence that there is a positive bi-directional relationship between GDP growth and trade openness. Second, fluctuations of GDP growth are explained by the size of the informal economy, while the impact of GDP growth on the size of the informal economy is not found to be robust with respect to change in VAR order. Moreover, the size of the informal economy affects GDP growth more than openness, and the causality from openness to GDP growth is slightly stronger than the causality from GDP growth to openness. Finally, there is no conclusive, robust evidence regarding the interaction between the size of the informal economy and trade openness.

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1 Introduction

Improvements in estimation techniques regarding the size of the informal economy has led researchers into an intensive debate about both the determinants and the impacts of informal economy. Many studies examine the impact of informality on economic growth and trade openness, but few try to understand the dynamic relationships between these three important indicators of the macroeconomic environment.

Aside from the impact of the informal economy on overall economic growth and trade openness, the interaction between growth and openness has been investigated in the debates. However, both theoretical and empirical studies on this issue present mixed pictures of the linkages between growth and openness.

Aiming to bring these two streams of literature together and to further our understanding of the dynamic relationships between the size of the informal economy, economic growth, and trade openness, in this paper I use a panel vector autoregression (panel VAR) approach so as to discover the bi-directional causality between these variables as suggested by Rodriguez and Rodrik (2001).

Using panel data for 12 advanced economies over the period from 1964:1 to 2010:4, first, it is found that there is a positive bi-directional relationship between GDP growth and openness. Second, enlargement of the informal economy contributes to GDP growth, but the result regarding the impact of GDP growth on the size of the informal economy is not found to be robust with respect to the change in VAR order. Moreover, the size of the informal economy has a greater impact on GDP growth than does openness, and the causality from openness to GDP growth is slightly stronger than the causality from GDP growth to openness. Finally, there is no conclusive, robust evidence concerning the interaction between the size of the informal economy and trade openness.

The rest of the article is organized as follows. Section 2 outlines related literature and the motivation for this paper in more detail. Section 3 presents the econometric methodology along with the data set, and Section 4 reports the empirical results. Finally, Section 5 provides some concluding remarks.

2 Motivation

This paper takes note of contrasting viewpoints on the impact of the size of the informal economy on both economic growth and trade openness, and the direction of causality between growth and openness, then tries to account for the linkages between these three variables by allowing bi-directional interaction, as suggested by Rodriguez and Rodrik (2001). In this paper, the size of the informal economy is used as the country specific variable during the investigation of the relationships between growth and openness to address the second suggestion of Rodriguez and Rodrik (2001).

There are two opposed views about the impact of informality on economic growth. Loayza (1997), Johnson et al. (1997), Massenot and Straub (2011), and De Soto (1989) claim that enlargement of the informal economy hurts economic growth because it decreases the availability of public services for all agents in the economy and increases inefficiency in the usage of public services. However, Nabi and Drine (2009), and Eliat and Zinnes (2000) conclude that an increase in the size of shadow economy could be accompanied by higher rates of economic

growth if a subsequent reduction in the size of the formal economy is offset by the increase in production.

There is an intensive discussion about the relationship between informality and trade openness. Although the trade theory literature suggests that trade liberalization causes a rise in informality, empirical studies give a mixed picture. Fugazza and Fiess (2010), for example, tries to determine the sign of the relationship between trade liberalization and informality using three different data sets but concludes that while macro-founded data produce results supporting the conventional view, micro-founded data do not. Moreover, Goldberg and Pavcnick (2003) builds a dynamic efficiency wage model to examine the impact of trade liberalization on the size of the informal sector, and then uses a data set including Brazil and Colombia to investigate the empirical implications of the model. However, their results provide no evidence of increased foreign competition in developing countries leading to an expansion of the informal sector.

Finally, aside from the linkages between informality and economic growth, and informality and trade openness, the interaction between trade openness and economic growth has received considerable attention in recent decades as new regulations have been implemented to increase the benefits derived from trade. However, there are two separate views about the impact of openness on the economic growth in both theoretical and empirical studies.

On the empirical side, Edwards (1998) uses a comparative data set for 93 countries to examine the linkage between openness and TFP growth. He concludes that openness does spur economic growth due to the growth of TFP, and that the result is robust to the use of different openness indicators, estimation techniques, time periods and functional forms. Frankel and Romer (1999) finds a similar result by focusing on the geographic component of trade. Easterly and Levine (2001) corroborates the result, stating that the exogenous components of international openness are significantly correlated with the economic growth. However, in a more recent study, Sarkar (2007) finds in a time series analysis that the majority of the countries show no positive long-term relationship between openness and growth during 1961-2002. Also, in a cross country investigation, Yanikkaya (2003) argues that trade barriers are positively and, in most specifications, significantly correlated with growth, especially in developing countries.

The theoretical literature on growth reveals a very complex and ambiguous relationship between trade barriers and economic growth. Barro and Sala-i Martin (1997) and Romer (1993) claim that more open economies have an advantage in their efforts to catch up with advanced economies. Similarly, Chang et al. (2005) maintains that trade openness facilitates the efficient allocation of resources and technological progress. However, Rodriguez and Rodrik (2001) finds little evidence that open trade policies are significantly associated with economic growth. In their pioneering work, they suggest that during the investigation of the relationship between trade openness and economic growth, cross-country studies might yield greater insights by addressing the specific characteristics of countries. For instance, they claim that investigating the interaction between trade openness and economic growth might give different results in countries with a comparative advantage in primary products than those with comparative advantage in manufactured goods. They also suggest that these studies should allow for bi-directional causality between trade openness and economic growth since they claim that although conventional studies cover the impact of productivity on exports, microeconometric analysis of plant-level data sets shows that causality seems to flow from

productivity to exports, not vice versa.

In the existing literature, even though the impact of country specific factors are not addressed, several studies explore the bi-directional causality between economic growth and trade openness. Hsiao (1987), Jung and Marshall (1985), and Ahmad and Kwan (1991) use Granger causality tests to analyze cross-country data, but end up with differing results for the different country groups in their data set. Awokuse (2007) analyzes the short-run and long-run dynamics between openness and growth by using the concept of cointegration and error-correction for three transitional economies, but the results suggest a bi-directional causality between exports and growth for Bulgaria, a unidirectional causality from exports and imports to economic growth for Czech Republic, and a unidirectional causality from imports to economic growth for Poland in the long-run. Gries and Redlin (2012) uses the same methods for 158 countries over the period 1970-2009 and finds a positive significant causality from openness to growth, and vice versa in the long-run, and that openness damages an economy undergoing short-term adjustments. This paper also addresses the second suggestion of Rodriguez and Rodrik (2001), which is the inclusion of the impact of a country-specific factor in the investigation, by simply using the level of income of each country. They show that the inclusion of income-related subpanels in the data makes the long-run effects increasingly positive and significant, and the short-run adjustment becomes positive as income levels increase.

In line with the suggestions of Rodriguez and Rodrik (2001), in this paper, the size of the informal economy is used as the country specific variable for two reasons. First, the quarterly estimation of the size of the informal economy for 12 advanced economies in my data set shows that the size of the informal economy varies significantly across those countries even though there is a decreasing trend in the size of the informal economy for all of these countries. Second, the existing debate in the literature suggests strongly that there might be two way causality between both informality and economic growth, and informality and trade openness. Furthermore, it is reasonable to claim that a high degree of trade openness might stem from strong enforcement policies on the part of the government that reduces informality and thus increases the quality of goods and services that can be traded as the efficiency of production increases, which in turn stimulates economic growth. However, a similar intuition may also apply in the reverse. One may expect that the trade as a share of GDP of a country would be higher if the country enjoys higher economic growth, and this in turn minimizes the size of the informal economy since, by definition, the informal sector is assumed to be less productive than formal sector. This hypothesis is tested empirically in the following sections.

3 Econometric Methodology and Data

3.1 Methodology

I use panel VAR techniques to estimate the variance decompositions and the impulse response functions. The econometric model takes the following reduced form:

$$X_{it} = \Gamma(L)X_{it} + u_i + \epsilon_{it} \tag{1}$$

where X_{it} is a vector of stationary variables, $\Gamma(L)$ is a matrix polynomial in the lag operator with $\Gamma(L) = \Gamma_1 L^1 + \Gamma_2 L^2 + ... + \Gamma_n L^n$, u_i is a vector of time invariant, country specific effects

and ϵ_{it} is a vector of idiosyncratic errors.

Due to lagging dependent variables, the fixed effects are correlated with the regressors. Hence, if one uses the mean-differencing method to eliminate fixed effects, then the coefficients would be biased. To avoid this problem, I use forward mean-differencing (the Helmert procedure or orthogonal deviations) (see Arellano and Bover, 1995), following Love and Zicchino (2006). Note that this procedure removes only the forward mean, i.e. the mean of all the future observations available for each individual quarter. Since the transformation preserves the orthogonality between transformed variables and lagged regressors, one can use lagged regressors as instrumental variables and estimate the coefficients by system GMM.

Upon the estimation of all the coefficients of the panel VAR, the impulse response functions (IRFs) and the variance decompositions (VDCs) are computed.[1] Given a forecast time horizon, variance decompositions measure the contributions of each source of shock to the (forecast error) variance of each endogenous variable. The impulse response functions describe the reaction of one variable to changes in the innovations of another variable in the system, while holding all other shocks equal to zero. The main assumption here is that variables listed earlier in the VAR order affect the other variables contemporaneously, while variables listed later in the VAR order affect those listed earlier only after a lag. As a result, variables listed earlier in the VAR order are considered to be more exogenous.

Recall from the previous section that one of the main tasks of this paper is to examine two different directions of causality in the interaction between the three variables in the system. In the first direction, since the informal sector operates less efficiently than the formal sector, as suggested by Ordonez (2010), Loayza (1997), and Nabi and Drine (2009), the reduction in the size of the informal economy can facilitate the production of more qualified goods and increase the share of trade in official GDP. As a result, the increased level of trade contributes to GDP growth, as noted by Edwards (1998), Frankel and Romer (1999), and Easterly and Levine (2001). Thus, the VAR ordering in the first model is:

$$Model\ 1: \quad X_{it} = (\Delta \text{IS}_{it},\ \Delta \text{Openness}_{it},\ \Delta \text{GrGDP}_{it})$$

In the second way of reasoning, as Rodriguez and Rodrik (2001) suggests, increased levels of economic growth contributes to the trade openness. As a result, industries are required to produce better quality goods and services, and this, in turn, can decrease the size of the informal economy as the informal sector is assumed to be less productive than the formal sector. Hence, the VAR ordering in the second model is:

$$Model\ 2: \quad X_{it} = (\Delta \text{GrGDP}_{it},\ \Delta \text{Openness}_{it},\ \Delta \text{IS}_{it})$$

3.2 Data

Quarterly data on the size of the informal economy, defined as a percentage of official GDP, is calibrated from a two sector (formal and informal) dynamic general equilibrium model for 12 advanced economies over the period from 1964:1 to 2010:4 using a model based estimation methodology proposed by Elgin and Oztunali (2012), in which they construct an annual

[1]The panel VAR is estimated by using the package provided by Inessa Love. This package is used in Love and Zicchino (2006).

unbalanced 161-country panel data set over the period 1950 to 2009. Moreover, there are some other informal sector series, such as the one reported by Buehn and Schneider (2012), available in the literature; however these are available only for significantly shorter time intervals. In this paper, I prefer to use quarterly data to uncover short-run interactions between the variables. Unfortunately, the fact that the quarterly employment data, which is required for the calibration, is only available for 12 OECD economies severely limits the data size. One particular drawback of this is that the cross-country variation is limited due to the low number of countries in the data. However, the relatively large time-series dimension in my data set aims to offset this drawback.

Quarterly data on the trade openness is calculated by dividing the sum of total exports and imports by the official GDP for each quarter in all countries. Quarterly data for total exports and imports are taken from OECD International Trade and Balance of Payments. Finally, quarterly data for the real GDP are taken from OECD National Accounts.

The result is a highly balanced panel data for 12 OECD countries over the period from 1964:1 to 2010:4.[2] Table 1 provides descriptive statistics of three series used in the panel VAR analysis.

Table 1: Descriptive Statistics

	Mean	Std. Dev.	Minimum	Maximum	Observations
Growth of real GDP (%)	0.7511	1.1106	-5.4730	7.4173	2256
Trade Openness (% of GDP)	2.1411	2.3873	0.0011	12.3663	2256
Informal Sector (% of GDP)	17.0174	5.5312	8.3218	35.6681	2256

4 Empirical Results

The first step of the analysis is to look at the properties of the data. To test for the presence of the panel unit root, the following test results are reported: The Hadri Lanrange multiplier (Hadri LM) stationary test (Hadri, 2000), Im-Pesaran-Shin (IPS) test (Im, Pesaran, and Shin, 2003), and Harris-Tzavalis (HT) test (Harris and Tzavalis, 1999). Table 2 presents the results of these panel unit root tests.[3]

In Table 2, while the Hadri LM test rejects the null hypothesis that all the panels are stationary for three variables, IPS and HT tests conclude that the hypothesis that all the panels contain a unit root is rejected only for the GrGDP variable. Thus, IPS and HT tests suggest that some panels are stationary for the GrGDP variable. However, Hadri (2000) notes that one may also want to rely on a test in which the null and alternative hypotheses are reversed to help confirm or dismiss conclusions based on tests with the null hypothesis being nonstationarity. Moreover, the stationarity of GDP series is tested instead of GDP growth,

[2]List of Countries included in VAR: Australia, Austria, Canada, Finland, Germany, Ireland, Italy, Japan, Norway, Sweden, UK, USA.

[3]IS denotes the size of the informal economy, Openness denotes the trade openness, and GrGDP denotes the GDP growth.

Table 2: Panel Unit Root Test

	Hadri LM test	IPS test	HT test
IS	0.0000	0.5996	1.0000
ΔIS	0.8033	0.0000	0.0000
Openness	0.0000	0.1169	0.1681
ΔOpenness	0.7581	0.0000	0.0000
GrGDP	0.0019	0.0000	0.0000
ΔGrGDP	0.9988	0.0000	0.0000

P-values are reported for each test. While IPS and HT tests have as the null hypothesis that all the panels contain a unit root and the alternative hypothesis that some panels are stationary, the Hadri LM test has as the null hypothesis that all the panels are stationary, perhaps around a linear trend and the alternative hypothesis is that at least some of the panels contain a unit root.

and all of the three tests conclude that GDP series are nonstationary in levels. Therefore, this paper relies on the results of the Hadri LM test and considers the GrGDP variable as nonstationary in levels as IS and Openness. Next, the stationarity of the variables in first differences is tested and all of the tests suggest that all variables are stationary in their first differences. Therefore, I use the first difference of each variable in panel VAR models.

Next, Figure 1 and Figure 2 report graphs of impulse responses for Model 1 and Model 2, respectively. The advantage of examining impulse response functions (and not just VAR coefficients) is that they show the size of the impact of the shock, plus the rate at which the shock dissipates, allowing for interdependencies.

The impulse response functions in Figure 1 show that the size of the informal sector positively influences both trade openness and GDP growth. Figure 1 also shows that openness has a negative impact on the size of the informal economy, while it affects GDP growth positively. GDP growth has a negative impact on the size of the informal sector but a positive impact on openness.

Figure 2 displays that GDP growth has a positive impact on both the size of the informal economy and openness. Moreover, openness affects both GDP growth and the size of the informal economy positively. Finally, the size of the informal economy has a positive effect on GDP growth but a negative effect on openness.

More precisely, one conclude the following from the report graphs of impulse responses for Model 1 and Model 2: First, there is a bi-directional positive relationship between GDP growth and openness. Second, enlargement in the size of the informal economy increases the GDP growth but the result of the impact of GDP growth on the size of the informal economy is not robust with respect to the change in VAR order. Finally, there is no conclusive, robust evidence about the interaction between the size of the informal economy and trade openness. The finding that GDP growth responds positively to openness, and vice-versa, corroborates the idea that there might be bi-directional causality between GDP growth and openness presented by Rodriguez and Rodrik (2001). The finding that GDP growth responds positively to the informal economy size is line with Nabi and Drine (2009), and Eliat and Zinnes (2000).

Although impulse response functions analyze the impact of changes in one variable on another, they do not display the degree of importance of shocks on one variable in explaining

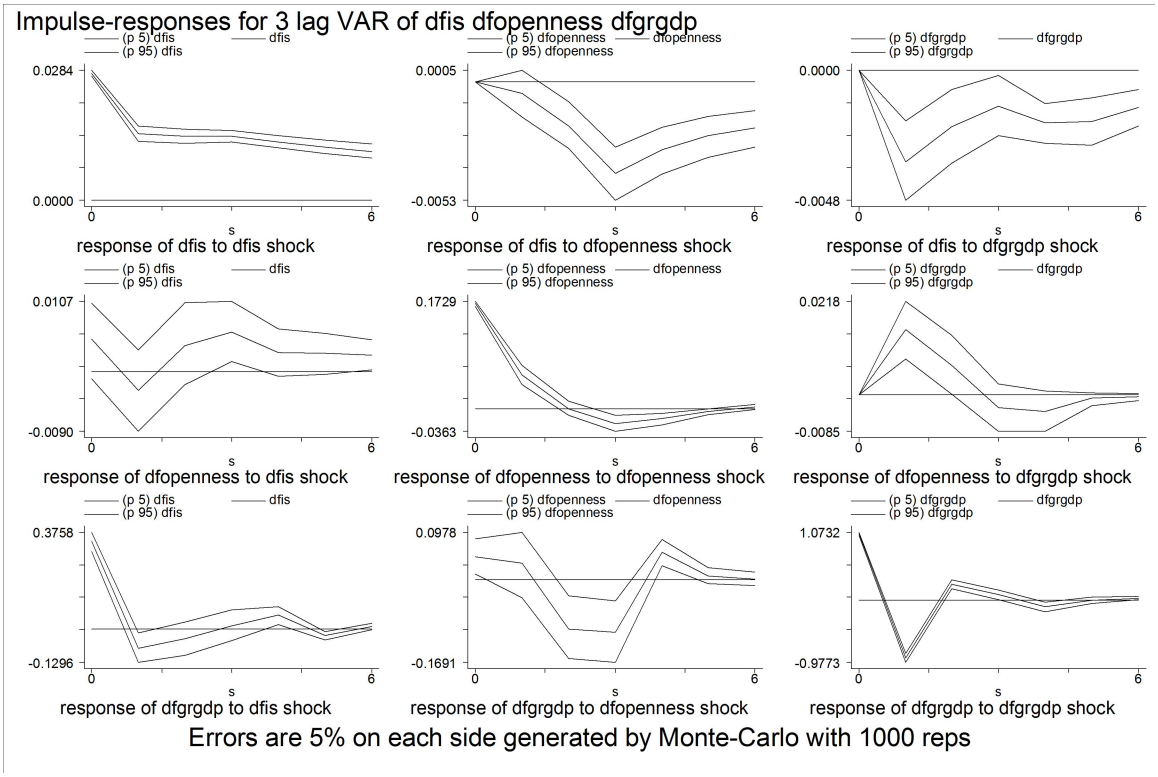

Figure 1: Impulse response functions - Model 1
Note: dfis, dfopenness, and dfgrgdp denote ΔIS, ΔOpenness, and ΔGrGDP respectively.

fluctuations in other variables. To account for the importance of changes in one variable in explaining changes in other variables, a variance decomposition is performed. Table 3 reports the variance decomposition analysis.

Table 3: Variance Decomposition Analysis

Model 1			
	ΔIS	ΔOpenness	ΔGrGDP
ΔIS	96.10	2.38	1.51
ΔOpenness	0.36	98.71	0.91
ΔGrGDP	5.86	1.30	92.82
Model 2			
	ΔGrGDP	ΔOpenness	ΔIS
ΔGrGDP	95.42	1.63	2.93
ΔOpenness	1.24	98.20	0.55
ΔIS	4.96	1.97	93.05

Percent of variation in the row variable (10 periods ahead) explained by column variable.

The variance decompositions show that openness explains approximately 1.3% and 1.6% of the fluctuations of GDP growth in Model 1 and Model 2, respectively, while GDP growth

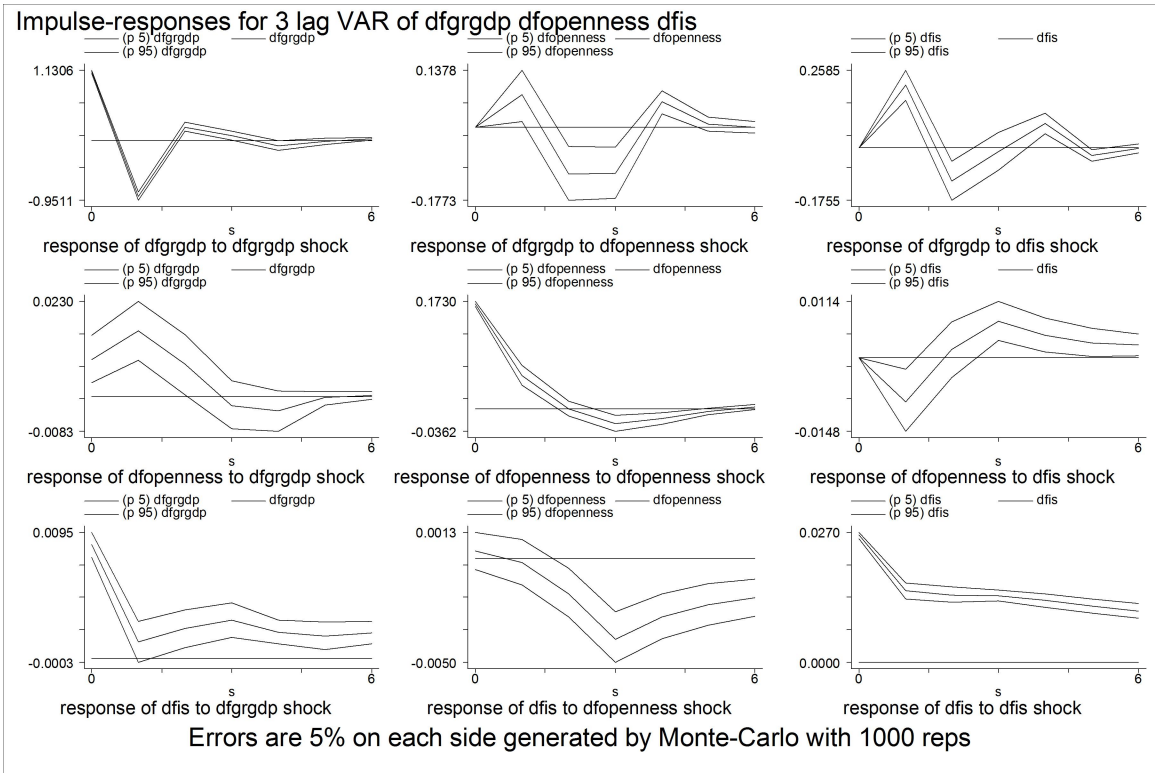

Figure 2: Impulse response functions - Model 2
Note: dfgrgdp, dfopenness, and dfis denote ΔGrGDP, ΔOpenness, and ΔIS respectively.

explains approximately 1% and 1.2% of the changes in openness. Thus, the significance of causality from openness to GDP growth is slightly higher than the significance of causality from GDP growth to openness. Moreover, the size of the informal economy explains approximately 6% and 3% of the changes in GDP growth in Model 1 and Model 2, respectively. Therefore, the impact of the size of the informal economy on GDP growth is higher than the impact of openness on GDP growth. Although variance decompositions show that GDP growth explains approximately 1.5% and 5% of the fluctuations of the size of the informal economy, impulse responses conclude that this direction of causality is not robust to change in VAR order.

5 Conclusion

This paper examines empirically the linkages between trade openness, GDP growth, and the size of the informal economy and tries to address two of the suggestions of Rodriguez and Rodrik (2001): Allowing for bi-directional causality between GDP growth and trade openness, and using a country specific factor during the investigation of the relationship between the two variables. A panel vector autoregression (panel VAR) is used approach so as to uncover bi-directional causality between the variables. Moreover, the size of the informal economy is considered as the country specific variable as it varies significantly across countries, and the existing debate in the literature strongly suggests that the size of the informal economy size

affects economic growth and trade openness.

The empirical study is conducted using a quarterly data of 12 advanced economies over the period from 1964:1 to 2010:4. In summary, there is evidence of a positive bi-directional relationship between GDP growth and trade openness. The fluctuations in GDP growth are explained by the size of the informal economy, while the impact of GDP growth on the size of the informal economy is not robust with respect to change in VAR order. Moreover, the size of the informal economy has a greater impact on GDP growth than does openness, and the causality from openness to GDP growth is slightly stronger than the causality from GDP growth to openness. Finally, there is no conclusive, robust evidence about the interaction between the size of the informal economy and trade openness.

This paper makes two significant contributions to the literature: First, this paper tries to account for endogenous linkages between GDP growth and trade openness by allowing bi-directional interaction between the variables, and uses the size of the informal economy as the country specific variable during the analysis. Hence, this paper actually tests, and then corroborates, the suggestions of Rodriguez and Rodrik (2001). Secondly, this paper uses quarterly data for three variables in the system to capture the short-term fluctuations. The usage of quarterly estimates of the informal economy size over a long time horizon especially strengthens the data set since other informal sector series in the literature are available only for significantly shorter time intervals and provide only yearly data on the size of the informal economy.

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