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TRADE LIBERALIZATION AND INFORMALITY: NEW STYLIZED FACTS

by

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Abstract

The relationship between trade liberalization and informal activity has not received the attention, whether theoretical or empirical, that it may deserve. The conventional view posits that trade liberalization would cause a rise in informality. This paper uses three different data sets to assess the sign of the relationship. Empirical results provide a mixed picture. Macro-founded data tend to produce results supporting the conventional view; micro-founded data do not. Empirical results also suggest that while informal output increases with deeper trade liberalization, informal employment falls.

Keywords: Informal sector, trade liberalization, cross-sectional analysis, time series analysis, panel analysis.

JEL classification: F13, F16, O17, C23

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1 Introduction

Informality refers to that share of a country's production of goods and services which does not comply with government regulation. Informal activity is a common feature of most countries, however it is greater in size and more pervasive in developing countries (Schneider and Enste, 2000; Tokman, 2007).

Informality is often linked to trade liberalization. Under the conventional view, the informal sector represents the inferior segment of a dual labour market, which expands countercyclically during downturns when workers are rationed out of the formal labour market. In this setting, trade liberalization, if perceived as a force of greater competition for domestic producers, is expected to lead to a rise in informality, as firms shed formal workers (inputs) to cut costs. However, this conventional view of informality has been challenged on various grounds.

Firstly, informal activity is not exclusively residual. There is significant evidence that informality, at least in parts, is driven by dynamic, small-scale entrepreneurial activity. This goes back to the seminal work of Hart (1972, 1973) on African labour markets, which has recently been confirmed for Latin America by Maloney (2004) and Perry et al. (2007). La Porta and Shleifer (2008) discuss the empirical relevance of various views on informality using three sets of surveys of both official and unofficial firms conducted recently by the World Bank.[1] The notion of informal entrepreneurship is also noticeable in ILO's official definition of informality adopted in 1993 by the International Conference of Labour Statisticians.[2]

Secondly, only certain types of shocks and a specific regulatory environment cause a countercyclical response of informal activity. Fiess, Fugazza and Maloney (2002, 2008) develop a theoretical model where the sign of the relationship between relative formal/informal earnings and the relative size of labour force depends on the nature of economic shocks and on the tightness of labour regulations. A rise in informality is not necessarily the outcome of a negative economic shock; it can also result from a positive shock to the non-tradable sector. The model is tested empirically using time series for Argentina, Brazil, Colombia and Mexico, and results confirm the existence of procyclical movements in line with theoretical predictions.

Thirdly, the relationship between trade liberalization and informality is ambiguous from both a theoretical and an empirical point of view. Moreover, empirical evidence for a large sample of countries is lacking.

[1] The enterprise surveys, the informal surveys and the micro surveys.

[2] The primary source is the International Labour Organization (ILO) (1993). In 2003, the International Conference of Labour Statisticians adopted statistical guidelines concerning this expanded concept of informal employment to complement the resolution concerning statistics on the informal sector adopted in 1993. The resulting framework allows countries to adapt the basic operational definition and criteria to their specific circumstances. In particular, flexibility is allowed with respect to the upper limit on the size of employment, the introduction of additional criteria such as non-registration of either the enterprise or its employees, the inclusion or exclusion of professionals or domestic employees, and the inclusion or exclusion of agriculture.

This paper provides comprehensive empirical evidence on the relationship between trade liberalization and informality for a large set of countries. For this purpose, we provide evidence from time series, cross-section and panel analyses. As informal activity by its very nature evades official records, measurement becomes a difficult issue. We use three alternative measures of informality, which have all been used in the literature, but never in parallel. The first is a survey-based measure of informal labour market activity from the International Labour Organization (ILO). The second is Schneider's (2005, 2007) measure of informal activity, which is derived from a combination of indirect measures of informal production based on excess currency demand and latent variable methodologies. The third is based on the macro-eclectic approach of Kaufmann and Kaliberda (1996), where the size of the informal economy is measured from the discrepancy between electricity consumption, which is taken as an indicator of overall economic activity, and the official gross domestic product (GDP).

Our empirical results offer a mixed picture, and no clear-cut conclusion can be drawn. While unconditional cross-sectional correlations support the view that trade liberalization induces a reduction of informality, whether in terms of employment share or in terms of output share, static panel results do not. Results from cointegration analysis suggest that more openness to trade is associated with greater informal employment and output for the majority of countries. Lower trade restrictions, on the contrary, appear to generate lower informal employment and output in most cases. Finally, systems GMM estimation generates contrasting results across data sets. In particular, fewer trade restrictions are associated with more informal output but less informal employment.

The rest of the paper is organized as follows: Section 2 reviews major theoretical and empirical contributions on the link between trade liberalization and informality. Section 3 describes the data and the empirical methodologies, and section 4 presents the results. The last section discusses possible policy implications and further research orientations.

2 Trade liberalization and informality: theoretical insights and country experiences

2.1 Theoretical insights

The relationship between trade liberalization and informality has received little attention, whether from a theoretical or an empirical point of view. According to a consensual but not necessarily formal argument, trade liberalization is expected to increase competition for domestic producers. In an effort to lower production costs, domestic producers will seek informally produced inputs (in the extreme, all inputs would be produced informally), which are cheaper since informal producers generally do not comply with labour or fiscal regulations. Greater demand for informally produced inputs is therefore expected to drive the extension of the informal sector following trade liberalization.

Goldberg and Pavcnik (2003) adopt a model that unambiguously generates such a positive relationship. Their model is based on a dynamic efficiency wage model with three

essential assumptions. First, the representative firm faces demand uncertainty. Second, the representative firm can hire workers either from a pool of formal or informal workers. Third, formal employment is subject to labour market legislation, and formal workers receive benefits and severance pay on dismissal. Trade liberalization is modelled as a change in the probability function that governs price shocks. The model by Goldberg and Pavcnik (2003) suggests that the impact of trade liberalization on informality depends on the degree of labour market liberalization: the less flexible labour markets are, the greater the reallocation from the formal to the informal sector.

However, not all theoretical models provide such clear-cut predictions on the relationship between trade liberalization and informality. For instance, in the heterogeneous firm model of Aleman-Castilla (2006), trade liberalization (i.e. lower trade costs) implies that some firms will find it more profitable to enter the formal sector, rather than remaining informal. The least productive informal firms will be forced to exit the industry, and only the most productive (formal) firms will export to international markets. Here, trade liberalization reduces the incidence of informality. Moreover, both – the exit of the least productive firms and the rise in output of the most productive (formal) firms – lead to an aggregate increase in productivity.

The above models assume that all goods can be traded in principle. Non-tradability is endogenously determined and depends only on firms' characteristics, not on goods' characteristics. If some goods are allowed to be non-tradable, the impact of trade liberalization on informality will additionally depend on the reaction of the real exchange rate and/or relative sector productivities. To illustrate, if the informal sector is equated with the non-tradable goods sector, and, if non-tradable goods are only for consumption, then the relationship between trade openness and informality could become negative. In this context, trade liberalization would lower the price of the non-tradable good in terms of the tradable good (i.e. a real depreciation), and this would decrease the size of the informal sector.[3] In certain circumstances, trade liberalization could lead to a real appreciation[4] and hence increase the size of the informal sector.

In a situation where formal firms use non-tradable (informal) goods as inputs, additional arbitrage conditions enter the relationship of trade liberalization and informality. Trade liberalization (a fall in trade costs) exposes uncompetitive firms to greater import competition. For these firms, the use of cheaper, informally produced inputs may present a survival strategy. However, as formal wages may well rise with greater labour demand from (old and new) exporting firms, informal wages may also increase to eliminate any arbitrage in workers' occupational choice. The sign of the relationship between trade liberalization and informality will therefore depend on which force dominates. Furthermore, if pre-reform formal wages are determined by labour regulation (e.g. a binding minimum nominal wage), upward pressures on formal wages after reform might be slightly undermined; this would increase the chance to observe more informality as a consequence of trade liberalization.

The fiscal environment can also influence the relationship between trade liberalization and informality. Existing models generally assume that public expenditures

[3] See, for instance Li (2004), for a theoretical treatment and empirical evidence.

[4] Calvo and Drazen (1998), for instance, show that trade liberalization of uncertain duration could lead to a real appreciation, due to an upward jump in the consumption of both tradable and non-tradable goods.

fully adapt to fiscal revenues, without specifying how fiscal adjustment is actually achieved. Fiscal consolidation may require higher taxes or new fiscal instruments, and both are likely to affect firms' incentives to extend informal inputs and workers' choices to become informal.

Theoretical predictions of how trade liberalization impacts informality are ambiguous at best; the overall size of the informal sector could rise or fall with trade liberalization. We next review existing empirical studies on trade liberalization and informality.

2.2 Country experiences

Empirical evidence on the relationship between trade liberalization and informality is limited and is generally country-specific. Most of the evidence relates to Brazil, Colombia and Mexico, for which rich relevant and reliable micro data sets are available.

Goldberg and Pavcnik (2003) use household survey data for Brazil and Colombia collected over the 1980s and 1990s. They find no evidence of any significant relationship between trade liberalization and informality in Brazil, whether positive of negative. For Colombia, they present evidence that informality increased after trade liberalization. However, this finding appears directly related to the degree of labour market flexibility. Goldberg and Pavcnik (2003) report that prior to labour market reform, when the costs of firing formal workers were high, an industry-specific tariff reduction was associated with a greater likelihood of becoming informal. Since labour market reform, however, industry-specific tariff reductions have been associated with smaller increases in the probability of becoming informal.

Aleman-Castilla (2006) uses the North American Free Trade Agreement (NAFTA) experience to assess the impact of trade liberalization on informality in Mexico. Using Mexican and United States import tariff data and the Mexican National Survey of Urban Labour, the Aleman-Castilla (2006) findings suggest that lower import tariffs are related to lower informality in tradable industries. Results also suggest that informality decreases less in industries where import penetration is high, and more in industries with greater export orientation.

Goldberg and Pavcnik (2003) and Aleman-Castilla (2006) use a similar two-step estimation approach. In the first step, a linear probability model of informal employment is estimated. Explanatory variables include worker characteristics and industry dummies capturing workers' industry affiliation. Coefficients of the latter are defined as industry-informality differentials. These differentials are then used as the dependent variable in the second-step estimations. They are regressed against import tariffs across years, and the resulting coefficients are taken as measures of the impact of trade liberalization on informality.

A related paper, although based on a different empirical approach, is Boni, Gosh and Maloney (2007). Boni et al. (2007) study gross worker flows to explain the rising informality in Brazil's metropolitan labour markets from 1983 to 2002. This period covers two economic cycles, several macroeconomic stabilization plans, a far-reaching trade liberalization, and changes in labour legislation through the constitutional reform of 1988.

Secular movements in the levels and the volatility of gross flows suggest that the rise in informality during that period was largely caused by a reduction in job-finding rates in the formal sector. Part of the remainder is linked to the constitutional reform which contributed to rising labour costs and reduced labour market flexibility; only a small fraction of the observed rise in informality is explained by trade liberalization.

In an earlier study, Currie and Harrison (1997) assess the impact of trade reform on employment in manufacturing firms in Morocco in the 1980s. This paper does not investigate the direct impact of trade reform on informality but offers insights on the role of trade protection on labour market composition. Currie and Harrison (1997) use a survey of manufacturing firms with more than 10 employees. Their results suggest that employment in the average firm has been unaffected by the reduction of tariffs and the elimination of quotas. However, the exporting firms and industries most affected by the reforms (textiles, beverages and apparel) experienced a significant decline in employment.[5] The results from Currie and Harrison (1997) further indicate that government-controlled firms behave quite differently from privately owned firms. Government-controlled firms actually increased employment in response to tariff reductions, mostly by hiring low-paid temporary workers.

Empirical studies to date suggest that informality can respond to trade liberalization either positively or negatively, depending on country and industry characteristics.

3 Data and empirical strategy

Our estimates of the size of the informal sector come from three different data sets. ILO's is a micro-founded, survey-based measure that provides a directly observable measure of the share of informal employment. The Schneider (2005, 2007) informality measure and the macro-eclectic approach (Kaufmann and Kaliberda, 1996) are both macro-founded, indirect measures of informal output in total GDP.

3.1 Data sets and dependent variables

The first data set used in this paper is from ILO. The ILO statistical definition of informality represents an important step towards a better and more consensual measurement of informality around the world. In 1993, the International Conference of Labour Statisticians adopted the following international statistical definition of the informal sector: namely, all unregistered (or unincorporated) enterprises below a certain size, including (a) micro-enterprises owned by informal employers who hire one or more employees on a continuing basis; and (b) own-account operations owned by individuals who may employ contributing family workers and employees on an occasional basis. Data from ILO on informal employment allow us to construct an unbalanced panel for 32 countries from 1990 to 2004; the corresponding variable is *Info_ILO*.

[5] The 24-point cut in tariff protection caused employment in exporting firms to fall by about 6 per cent. A 21-point cut in tariff protection for textiles, beverages and apparel brought about a 3.5 per cent decline in employment in these sectors.

The second data set used in this paper takes the estimates by Schneider (2005, 2007) of informal activity. Schneider's estimates are derived from a combination of the Currency Demand Approach and the DYMIMIC method of Giles. Schneider (2005) provides a snapshot of informality for 110 countries in 1990/91, 1994/95 and 1999/2000, and Schneider (2007) provides annual observations for the same countries during 2000 and 2004. The corresponding variable is *Info_S*.

Third, we use the macro-eclectic approach proposed by Kaufmann and Kaliberda (1996). According to this method, the size of the informal economy may be measured from any discrepancy between an indicator of the overall economic activity and the official gross domestic product. Given the high correlation between consumption of electricity and economic activity, the growth rate of electricity consumption serves as an indicator of the evolution of the total gross domestic product. Any difference between the growth of electricity consumption and the growth of the official gross domestic product is attributed to changes in the size of the informal economy. We use data on total electricity consumption from *World Development Indicators* and on real GDP from the International Monetary Fund's *International Financial Statistics* (2006), and seed values for the size of the informal economy for 2000 from Schneider (2007). An advantage of the macro-eclectic approach is that it is the least data-intensive. It enables us, therefore, to construct a balanced panel on informality from 1990 to 2004 for 66 countries. The corresponding variable is *Info_Macro*.[6]

None of our three measure of informality is, however, without criticism. While the surveys-based *Info_ILO* provides a direct measure of the information required to identify the informal sector, surveys commonly suffer from several errors related to design, coverage, non-response, and measurement and processing. Furthermore, differences in national survey design often make comparison across countries and over time difficult.

The macro-eclectic approach has been mainly criticized on the following grounds, and similar criticism extends to Schneider (2005, 2007): (a) a large part of informal activity (e.g. personal services) does not require intensive energy use, or could be supplied from alternative energy sources (e.g. coal, wood); (b) technological progress has prompted efficiency gains in both demand and supply of energy (e.g. low-energy devices) as well as money (e.g. credit cards, online banking); and (c) the elasticity of electricity/GDP or money demand/GDP may not be stable over time or across countries.

Despite these issues, there is a reasonable amount of correlation between these different estimates of informal activity. Appendix 2 (table A3 and figs. A1 and A2) provides the respective correlation coefficients. Correlation is highest in the cross-section. As an example, in 2004, *Info_S* correlates at 0.78 with *Info_ILO; Info_Macro* correlates with the *Info_ ILO* measure at 0.68. Correlation is the highest between *Info_S* and *Info_Macro* at 0.97.

To assess co-movement between alternative measures of informality over time, we look at the correlation between changes in *Info_ILO* and *Info_S* during 2000 and 2004, and also at cointegration between *Info_ILO* and *Info_Macro* between 1990 and 2004 (appendix 2, table A4). Even though co-movement between different informality measures over time

[6] Country coverage for the macro-eclectic and ILO measures are reported in appendix 1. See Schneider (2007) for a listing of the countries in his sample.

is lower compared to the correlation in the cross-section, co-movement is nevertheless sizeable. The correlation between first differences in *Info_ILO* and *Info_S* is 0.38 during 2000 and 2004. Cointegration tests between the ILO measure and the macro-eclectic measure of informality indicate that 16 out of 23 series (about 70 per cent) are cointegrated (see table A5 in appendix 2).[7]

3.2 Explanatory variables

Following Rodríguez and Rodrik (2000), we use different proxies for trade openness to investigate the stability of our results. In the context of the trade-growth literature, Rodríguez and Rodrik (2000) show that the positive impact of trade on growth is less robust than often claimed and subject to difficulties in measuring openness.

The variable *Trade/GDP* measures total merchandise trade as a percentage of GDP and is taken from *World Development Indicators* (World Bank, 2007). The variable *Tariff* measures a country's effectively applied average external tariff rate.[8] The measure comes from the UNCTAD-TRAINS database.[9]

Dreher (2006) presents an index of globalization (the KOF Index of Globalization) that comprises three dimensions of globalization that have been highlighted by Keohane and Nye (2000) and others. Economic globalization captures economic flows of goods, capital and services. Political globalization refers to the international diffusion of policy, and social globalization captures the spread of ideas, information, images, and people around the world. These three indices make up the overall globalization index, and consist by themselves of various sub-components, where the sub-component economic globalization is of most interest to us. The economic globalization index consists of two sub-components: actual economic flows (*KOF-Flows*) and trade restrictions (*KOF-Restrictions*). The sub-index on actual economic flows includes data on trade, foreign direct investment (FDI) and portfolio investment. Data on trade (the sum of a country's exports and imports) and FDI flows are provided by the World Bank's *World Development Indicators*, and stocks of FDI are provided by UNCTAD's *World Investment Report*. Portfolio investment is derived from the International Monetary Fund's *International Financial Statistics*. The sub-index of restrictions on trade and capital takes in hidden import barriers, mean tariff rates, taxes on international trade (as a share of current revenue) and an index of capital controls. The data for this index come mainly from Gwartney and Lawson (2006).

We also considered the trade liberalization index of Wacziarg and Welch (2008), which extends the Sachs and Warner (1995) measure of openness and makes it more robust. However, as underlined in Wacziarg and Welch (2008), the panel variability of the

[7] The use of first differences on cointegation analysis seems justified given the evidence of non-stationarity presented in section 4.2.

[8] The concept of effectively applied tariff is defined as the lowest available tariff. If a preferential tariff exists, it will be used as the effectively applied tariff. Otherwise, the most favoured nation applied tariff will be used.

[9] The UNCTAD–TRAINS (Trade Analysis Information System) database is available at http://wits.worldbank.org.

indicator is extremely limited for the 1990s; we therefore consider it only in our cross-sectional analysis.

The selection of other explanatory variables is guided by the empirical literature. They are the following:

lGDPpc refers to the log of GDP per capita in constant 2000 United States dollars and is taken from *World Development Indicators* (World Bank, 2007). The relationship between informality and GDP per capita has been documented in various studies. For instance, Blau (1987), Maloney (2001), Gollin (2002) and Loayza and Rigolini (2006) assess the relationship between GDP per capita and self-employment.

The variable *Lab_Flex* measures labour market flexibility and consists of the Fraser Institute index of labour freedom as published in Gwartney and Lawson (2006). The index is a composite of four equally weighted components, consisting of minimum wages, rigidity of hours, difficulty of firing redundant employees, and cost of firing redundant workers. The index goes from 0 to 10, where 10 represents the highest degree of flexibility. The general burden imposed by stringent regulation, in particular in the labour market, is generally perceived as an important determinant of informality. Various empirical findings (e.g. Goldberg and Pavnic (2003) discussed previously, and Heckman and Pages (2000)) support this view.

The variable *Corruption* measures freedom from corruption. *Corruption* is equivalent to the sub-component Corruption of the International Country Risk Guide. The index goes from 1 to 6, where 6 represents the lowest level of corruption. This variable is usually included in regressions to control for the overall quality and efficiency of institutions in promoting formal economic activities. A more corrupt economy could be associated with poorer institutions and higher costs of production in the formal sector, as expressed, for instance, in de Soto (1989).

4 Results

Panel data are by definition two-dimensional: cross-sectional and time. We first exploit the two composing dimensions separately, in order to inform and qualify panel results. Cross-sectional analysis indicates how the relationship between informality and trade varies across countries at a given point in time; time series analysis investigates the change in the relationship between informality and trade over time within a given country. Inference from time series analysis is also important to guide the panel approach. For instance, non-stationary introduces severe biases with purely static panel estimation, which makes a dynamic estimation approach more appropriate.

4.1 Cross-sectional evidence

We first explore cross-sectional evidence. Table 1 displays unconditional correlations between the three alternative measures of informality and our explanatory variables. High GDP per capita and low levels of corruption are significantly correlated with low levels of informality, independently of the measure of informality applied. Labour market flexibility is only significantly correlated with *Info_Macro*, however the correlation is low (-0.13). There is a significant relationship between trade and informality, and measures of trade restrictions (*Tariff*, *KOF-Restrictions)*, measures of trade volume (*Trade/GDP* and *KOF-Flows)*, and the Wacziarg and Welch (2008) indicator of trade openness all point in the same direction, namely that trade openness appears to be negatively associated with informality: lower tariffs and greater trade flows are associated with lower levels of informality. The relationship is most apparent between informality and trade restrictions, and we find a particularly strong correlation between the *KOF-Restrictions* and *Info_ILO* (0.81).

Appendix 3 (figs. A3 to A5) presents scatter plots between the various measures of informality and trade; the relationship appears not sensitive to excluding developed countries.

There is further significant correlation between our control variables, in particularly corruption and GDP per capita (0.71), and also between the alternative measures of trade. However, correlations among the trade variables range from 0.12 to 0.69. This suggests that our different trade variables capture different dimensions of trade openness.

Table 1. Alternative measures of informality: 1990–2004, annual data

	ILO	Schneider (2007)	electricity consumption	GDP per capita	Corruption	Labour Market flexibility	Trade/ GDP	Tariff	KOF (trade flows)	KOF (restrictions)
GDP per capita	-0.88*	-0.68*	-0.65*	1						
Corruption	-0.72*	-0.62*	-0.57*	0.67*	1					
Labour market flexibility	0.02	0.02	-0.13*	0.11*	0.06	1				
Trade/GDP	-0.16*	-0.19*	-0.17*	0.23*	0.13*	0.21*	1			
Tariff	0.70*	0.37*	0.22*	-0.57*	-0.42*	-0.26*	-0.30*	1		
KOF (trade flows)	-0.43*	-0.22*	-0.19*	0.51*	0.35*	-0.12*	0.58*	-0.49*	1	
KOF (restrictions)	-0.81*	-0.52*	-0.53*	0.88*	0.61*	0.05	0.27*	-0.70*	0.61*	1
Wacziarg and Welch (2008)	-0.24*	-0.14	-0.13*	0.26*	0.19*	0.07	0.12*	-0.61*	0.22*	0.36*

Note: * indicates significance at the 1 per cent level of significance.

4.2 Time series evidence

We first pre-test our data for non-stationarity using the Im, Pesaran and Shin (2003), Hadri (2000) and Madalla and Wu (1999) panel unit root tests.

Unit root tests

The Im et al. (2003) and Hadri (2000) panel unit root tests both require balanced panels; we therefore also apply the Maddala and Wu (1999) test. This test, which is also referred to as the Fisher test, combines the p-values from *N* independent unit root tests. It assumes that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary. Z_{Fisher} follows a chi-square distribution with *N**2 degrees of freedom. Due to the pooling of p-values from independent unit root tests, Z_{Fisher} can be applied to unbalanced panels.

Table 2 reports the results of the unit root tests and provides strong evidence in favour of non-stationarity. The Im et al. (2003) Z_{IPS} panel unit root tests only reject the null hypothesis of a unit root for *KOF-Flows*. The Hadri (2000) Z_{μ} panel rejects the null of stationarity for all variables. Results based on the Fisher tests of Madalla and Wu (1999) only fail to reject the null hypothesis of panel unit roots for *Trade/GDP*.

Table 2. Panel unit root tests: 1990–2004

	Z_{IPS}	Z_{μ}	Z_{Fisher}
Macro-eclectic informality	-0.784	52.68*	140.80
ILO informality			48.14
GDP per capita	: -1.555	60.28*	: 84.34
Corruption			: 112.88
Labour market flexibility			122.91
Trade/GDP	-1.458	38.29*	125.5
Tariff			106.2
KOF (trade flows)	-1.657*	45.85*	147.2
KOF (restrictions)	1990–2004: -1.069 (N=55, T =15) 1971–2004: -0.882 (N=55, T =34)	1990–2004: 49.68* (N=55, T =15) 1971–2004: 127.4* (N=55, T =34)	1990–2004: 98.8 (N=55, T^{max} =15) 1971–2004: 33.1 (N=55, T^{max} =34)

Notes: For these test statistics, an asterisk (*) denotes rejection of the null hypothesis. Z_{IPS} is the Im et al. (2003) panel unit root test, see equation (6) – it contains a constant and has a critical value at the 5 per cent significance level of -1.65. The Hadri (2000) Z_{μ}test statistic corresponding to equation (9) has a null hypothesis of stationarity and is distributed as standard normal. The Maddala and Wu (1999) panel unit root tests, also referred to as the Fisher test Z_{Fisher}, combines the p-values from N independent unit root tests; it assumes that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary. Due to the pooling of p-values from independent unit root tests, Z_{Fisher} can be applied to unbalanced panels.

Cointegration analysis

Given strong evidence of non-stationarity, we use the Johansen (1988, 2002) cointegration approach to investigate the relationship between informality and trade liberalization from a time series perspective. In the presence of cointegration, super-consistency implies that we can concentrate on the relationship between informality and trade liberalization without fear of omitted variable bias; we therefore abstract from other control variables in this section.[10]

Given the relatively small sample sizes, we simulate critical values and apply a Bartlett correction to the trace statistics following Johansen (2002).

We find strong evidence of cointegration between both measures of informality and two trade liberalization indicators (*Trade/GDP* and *KOF-Restrictions*). The results of the individual cointegration tests are displayed in tables A6 and A7 in appendix 4. The coefficients are in vector form and normalized on the informality variable (not reported).

There appears to be a fair degree of heterogeneity with respect to the sign of the empirical relationship between trade liberalization and informality. For *Trade/GDP* and *Info_Macro* we find that in almost 70 per cent of cases, greater trade openness is associated with higher informality between 1990 and 2004. For Trade/GDP and Info_ILO, we find a near 50:50 split between countries where informality rises or falls with trade liberalization. Not all countries in Info_Macro are available for Info_ILO; for countries that appear in both data sets, signs coincide in almost 60 per cent of cases.

The results are similar when considering KOF-Restrictions as the measure of trade liberalization. In 70 per cent of cases, lower restrictions on trade have led to an increase of informal output, according to Info_Macro. For the Info_ ILO set, the split remains around 50:50. Where we have country information from both informality data sets, the results are coherent in almost two thirds of observable cases.

Our time series results by country seem to corroborate evidence from cases studies in the literature. We support the Goldberg and Pavcnik (2003) findings of a more positive link between trade liberalization and informality in Colombia (deeper trade liberalization increases informality). We also support the Currie and Harrison (1998) finding of an adverse impact of trade liberalization on informality in Morocco. Trade/GDP and KOF_Restrictions provide contradictory evidence on the relationship between trade openness and informality for Brazil and Mexico, and this may explain why Goldberg and Pavcnik (2003) and Aleman-Castilla (2006) fail to identify a clear relationship in these two countries.

Overall, time series analysis indicates that for a given country, different measures of informality do not necessarily respond in a similar manner to the same measure of trade liberalization. Conversely, the same measure of informality does not relate to different measures of trade liberalization in the same fashion. However, if a dominant pattern had to be identified, results suggest that it should be the conventional view: greater openness to trade leads to higher informality, whether the latter is thought of in terms of employment or in terms of output.

[10] For a discussion of super-consistency, see Stock (1987).

4.3 Panel evidence

Cross-sectional analysis and time series investigation produce contrasting results, suggesting that an approach that merges both dimensions is needed before any possibly robust and clear-cut conclusion can be reached.

Time series analysis points to unit roots in most of the variables under consideration. This would make the Pooled Mean Group (PMG) estimator of Pesaran, Shin and Smith (1999), which explicitly accounts for non-stationarity, appropriate. To robustify results, however, we also report panel estimates based on static fixed effects and on systems GMM. The latter approach is able to accommodate possible endogeneity of any of our explanatory variables.

The PMG estimator requires a near-balanced panel, and can, therefore, only be applied to *Info_Macro*. GMM works best for large *N* and small *T*, which makes it ideal for *Info_S*, where we have four time series observations on informality, for 1990, 1995, 2000 and 2004.

Static approach: fixed effects

A fixed effects static approach excludes the explicit treatment of both non-stationarity and endogeneity issues. Labour market flexibility and the corruption indices are not found to be significant in any of the fixed effects regressions. Because of their low time variability over the period under scrutiny, both variables effects are likely to be absorbed by the country fixed effects. Therefore, we removed them from estimations, without loss of either efficiency or power.

Table 3 provides the findings for *Info_Macro* and table 4 for *Info_ILO*.[11] Since Pesaran's 2004 test of cross-sectional independence indicates the presence of cross-sectional correlation for *Info_Macro*, we include time dummies. Time dummies appear to be sufficient to remove the cross-sectional correlation in the panel.[12]

Both data sets generate comparable results in both sign and magnitude for most indicators of trade liberalization. The *Info_Macro* panel (table 3) strongly suggests that more openness and lower tariffs lead to higher informality. The *Info_ILO* panel (table 4) broadly corroborates this story, although coefficient estimates are sometimes only significant at the 10 per cent level.

[11] The results for *Info_S* are not reported here, as they are quite similar to those obtained for *Info_Macro*.

[12] We also included cross-sectional averages of dependent and independent variables as an alternative means to account for cross-sectional dependence, and the results are similar.

Table 3. Fixed effects: macro-eclectic measure of informality

	TRADE	TRADE FLOWS	TARIFF	TRADE RESTRICTIONS
Lgdppc	-0.088*** (0.0142)	-0.0865*** (0.0149)	-0.0771*** (0.0224)	-0.0891*** (0.01494)
Trade openness				
Trade/GDP	-0.000 (0.001)			
Trade flow KOF		-0.000 (0.0002)		
Tariff			-0.0012*** (0.0002)	
Trade restrictions KOF				0.00066** (0.0003)
Constant	0.9845*** (0.1154)	1.034*** (0.1274)	0.908*** (0.175)	1.021*** (0.1208)
Nobs/groups	990/ 66	915/61	617/ 53	825/55
Overall R2	0.44	0.45	0.43	0.41

Table 4. Fixed effects: ILO measure of informality

	TRADE	TRADE FLOWS	TARIFF	TRADE RESTRICTIONS
Lgdppc	-0.0207* (0.0130)	-0.03401** (0.1732)	-0.02616 (0.02205)	-0.0339*** (0.1525)
Trade openness				
Trade/GDP	0.00021* (000013)			
Trade flows KOF		0.00071** (0.00036)		
Tariff			-0.00161* (0.00094)	
Trade restrictions KOF				0.00069*** (0.000259)
Constant	0.4329*** (0.1110)	0.5096*** (0.1380)	0.5224*** (0.1998)	0.5168*** (0.1267)
Nobs/groups	310/ 30	301/ 29	245/ 28	286/ 28
Overall R2	0.54	0.60	0.68	0.64

Dynamic non-stationary panel: Pooled Mean Group estimates

To account for non-stationarity in panels, we apply the Pooled Mean Group (PMG) and the Mean Group (MG) estimator. The MG estimator (see Pesaran and Smith, 1995) is based on estimating *N* time-series regressions and averaging the coefficients, while the PMG estimator relies on a combination of pooling and averaging of coefficients. The MG estimator allows intercepts, slopes and error variances to differ, while the PMG estimator imposes homogeneity on long-run coefficients across groups. If homogeneity cannot be rejected, the PMG estimator is consistent and more efficient than the MG estimator. Hausman tests select the PMG as the efficient estimator and indicate that the long-run relationship identified between trade openness and informality holds across groups. Results are provided in table 5. Coefficient estimates are similar in size to results based on static fixed effects, but they are generally more significant; they also suggest that more openness and fewer restrictions on trade lead to higher informal output.

Table 5. Pooled Mean Group estimates: macro-eclectic measure of informality

	TRADE	**TRADE FLOWS**	**TRADE RESTRICTIONS**
Lgdppc	-0.0117 (0.082)	-0.0800*** (0.0033)	-.03390*** (0.0127)
Trade openness			
Trade/GDP	0.00035* (0.0001)		
Trade flows KOF		0.0006*** (0.0001)	
Tariff			
Trade restrictions KOF			0.0006* (0.0000)
Nobs/groups	990/ 66	915/61	825/55
Hausman test of efficiency of PMG over MG	$\chi^2(3) = 2.09$ p=0.55 $\chi^2(2) = 0.53$ p=0.77	$\chi^2(3) = 7.85$ p=0.05 $\chi^2(2) = 3.05$ p=0.22	$\chi^2(3) = 1.44$ p=0.69 $\chi^2(2) = 0.58$ p=0.75

Endogeneity

Fixed effects and PMG estimations do not account for possible endogeneity. Endogeneity could arise if the size of the informal sector influences the degree of trade liberalization in a country. An economy which is largely informal is likely to be poorly industrialized. In that context, economic power is usually highly concentrated and could be expected to be closely related to political power. Any reform would then most likely be guided by vested interests. In the case of trade policy, a strong preference for high protection for domestic productive sectors would most probably be the dominant decision factor in any reform. As a consequence, lower tariff cuts would be observed in economies with relatively larger informal sectors.

We then formally test for endogeneity in various cross-sections retrieved from our panel data set (not reported). We do find evidence – although it is not systematic – of endogeneity. This suggests that results obtained in a dynamic GMM panel set-up are likely to be the most reliable.

Dynamic approach: Generalized Method of Moments

We implement the Arellano and Bond (1991) and Blundell and Bond (1998) Dynamic Panel Data Estimator. The approach is based on the Generalized Method of Moments (GMM) and a systems estimator for our instruments (lagged values of the variables themselves).

Tables 6, 7 and 8 report results for *Info_Macro*, *Info_ILO* and *Info_S*. Contrary to the results found with static panel estimations and PMG, the different measures of informality do not generate fully consistent results.

As expected, we find that informality decreases with GDP per capita in all cases. Less corrupted administrations are also associated with less informality. The labour flexibility variable enters the estimation with the expected sign (not reported): more flexible labour markets reduce the incidence of informality. However, it is never significant at a reasonable level of confidence.

Trade liberalization measured as the share of total trade in GDP enters insignificantly in all estimations. The composite flow measure from the KOF Index of Globalization (*KOF-Flows*) is significant for the two macro measures of informality. Coefficient estimates are always positive when significant. This indicates that more openness to trade generates higher shares of informal production.

When using tariffs or *KOF-Restrictions* as the indicator of trade liberalization, we find that coefficient estimates are significant at least at 10 per cent in all regressions but one. We find contrasting evidence across data sets, but not across indicators. For the two macro data sets (*Info_Macro* and *Info*_S), less restricted trade is always associated with a larger share of informal output in total GDP. For *Info_ILO*, the share of informal employment falls with less restricted trade for both indicators of trade liberalization.

In all set-ups, results are not affected by the number of endogenous variables. It is well known that too many instruments in system GMM can bias the results. Our results are further robust to the inclusion of time dummies. However, we find that coefficient estimates prove robust to treating all variables as endogenous or only trade and informality, which improves the group/instrument ratio (second column of tables 6 and 7).

Table 6. Results from GMM (macro-eclectic informality measure)

	ALL INSTRUMENTED	**ONLY TRADE AND INF ENDOGENOUS**	**ALL INSTRUMENTED**	**ONLY TRADE AND INF ENDOGENOUS**	**ALL INSTRUMENTED**	**ONLY TRADE AND INF ENDOGENOUS**	**ALL INSTRUMENTED**	**ONLY TRADE AND INF ENDOGENOUS**
	TRADE	*TRADE*	*TRADE FLOWS*	*TRADE FLOWS*	*TARIFF*	*TARIFF*	*TRADE RESTRICTIONS*	*TRADE RESTRICTIONS*
Lgdppc	-0.0607*** (-4.85)	-0.0485*** (-5.38)	-0.0894*** (-6.40)	-0.0655*** (-6.62)	-0.0899*** (-5.21)	-0.071*** (-5.66)	-0.0877*** (-5.73)	-0.0877*** (-5.73)
Corruption	-0.0368*** (-4.69)	-0.0244*** (-3.07)	-0.0222*** (-2.06)	-0.0257*** (-3.66)	-0.0220*** (-2.05)	-0.0232*** (-2.83)	-0.0247*** (-2.79)	-0.0247*** (-2.79)
Trade openness								
Trade/GDP	-0.000 (-1.25)	0.000 (0.28)						
Trade flows KOF			0.0249*** (2.66)	0.00272*** (3.53)				
Tariff					-0.005*** (-3.71)	-0.004*** (-4.20)		
Trade restrictions KOF							0.00298*** (4.07)	0.00298*** (4.07)
Constant	0.938*** (8.43)	0.777*** (9.77)	0.9645*** (10.36)	0.7648*** (11.03)	1.17*** (8.92)	1.014*** (8.44)	0.916*** (9.54)	0.916*** (9.54)
Nobs	896	896	840	840	581	581	742	742
Number of groups/Number of instruments	64/113	64/59	60/113	60/59	49/113	49/59	53/59	49/59
Hansen test	Chi2(136) = 62.93 p=1.00	Chi2(55) = 56.1 p=0.435	Chi2(109) = 59.10 p=1.00	Chi2(109) = 59.10 p=1.00	Chi2(109) = 41.21 p=1.00	Chi2(55) = 47.5 p=0.755	Chi2(81) = 51.24 p=0.996	Chi2(55) = 47.5 p=0.753
Arellano-Bond test of AR(1) in first differences	z=0.38, p=0.70	z= 0.04, p=0.97	z=-0.56, p=0.58	z=-0.56, p=0.58 z= -0.15, p=0.88	z=0.90, p=0.37	z=0.59, p=0.56	z=0.47, p=0.64	z=0.43, p=0.66
Arellano-Bond test of AR(2) in first differences	z= -0.22, p=0.83	z= -0.09, p=0.93	z= -0.15, p=0.88		z=-0.41, p=0.68	z=-0.50, p=0.62	z=-0.47, p=0.64	z=-0.45, p=0.66

Table 7. Results from GMM (ILO informality measure)

	ALL INSTRUMENTED	**ONLY TRADE AND INF ENDOGENOUS**	**ALL INSTRUMENTED**	**ONLY TRADE AND INF ENDOGENOUS**	**ALL INSTRUMENTED**	**ONLY TRADE AND INF ENDOGENOUS**	**ALL INSTRUMENTED**	**ONLY TRADE AND INF ENDOGENOUS**
	TRADE	*TRADE*	*TRADE FLOWS*	*TRADE FLOWS*	*TARIFF*	*TARIFF*	*TRADE RESTRICTIONS*	*TRADE RESTRICTIONS*
Lgdppc	-0.100*** (-7.85)	-0.0953*** (-8.71)	-0.103*** (-8.72)	-0.0911*** (-6.86)	-0.0712*** (-4.47)	-0.0645*** (-3.72)	-0.065*** (-2.76)	-0.0654*** (-1.91)
Corruption	-0.0158*** (-1.39)	-0.0225*** (-2.48)	-0.0167*** (-1.94)	-0.0215*** (-2.54)	-0.028*** (-1.88)	-0.0226*** (-1.80)	-0.019*** (-1.86)	-0.0154 (-1.63)
Trade openness								
Trade/GDP	-0.000 (-1.08)	-0.000 (-1.64)						
Trade flows KOF			-0.000 (-1.57)	-0.0015 (-1.19)				
Tariff					0.0679*** (3.08)	0.0079*** (3.59)		
Trade restrictions KOF							-0.0028** (-1.95)	-0.0030 (-1.29)
Constant	1.24*** (13.11)	1.29*** (14.31)	1.32*** (10.93)	1.28*** (10.68)	0.958*** (8.21)	0.872 (6.38)	1.121*** (11.61)	1.124*** (6.97)
Nobs	335	335	326	326	270	270	311	311
Number of groups/ Number of instruments	32/110	32/58	31/110	31/58	30/110	30/58	30/110	30/58
Hansen test	Chi2(106) = 27.08 p=1.00	Chi2(54) = 26.8 p=0.99	Chi2(106) = 25.5 p=1.00	Chi2(54) = 27.1 p=0.99	Chi2(106) = 24.62 p=1.00	Chi2(54) = 22.49 p=1.00	Chi2(106) = 24.6 p=1.00	Chi2(54) = 25.6 p=1.000
Arellano-Bond test of AR(1) in first differences	z=0.62, p=0.54	z= 0.81, p=0.42	z= 1.02, p=0.31	z= 1.14, p=0.26	z=0.46, p=0.64	z=0.70, p=0.48	z=0.55, p=0.58	z=0.50, p=0.62
Arellano-Bond test of AR(2) in first differences	z= 0.79, p=0.43	z= 0.63, p=0.53	z= 0.88, p=0.38	z= 0.70, p=0.48	z= 0.02, p=0.98	z= 0.13, p=0.89	z=1.26, p=0.21	z=1.40, p=0.16

Table 8. Results from GMM analysis (Schneider (2007) informality measure)

	ALL INSTRUMENTED	**ALL INSTRUMENTED**	**ALL INSTRUMENTED**	**ALL INSTRUMENTED**
	TRADE	*TRADE FLOWS*	*TARIFF*	*TRADE RESTRICTIONS*
Lgdppc	-0.0419 (-1.43)	-0.0816***) (-6.13)	-0.0778*** (-4.39)	-0.0884*** (-4.34)
Corruption	-0.06638** (-1.96)	-0.0401*** (-3.58)	-0.03358* (-1.74)	-0.0503*** (-2.49)
Trade openness				
Trade/GDP	-0.0004 (-0.53)			
Trade flows KOF		0.0034*** (4.93)		
Tariff			-0.00216* (-1.70)	
Trade restrictions KOF				0.0028*** (4.48)
Constant	0.8898*** (5.42)	0.8984*** (9.44)	1.063*** (7.20)	1.017*** (7.15)
Nobs	256	240	152	212
Number of groups/Number of instruments	64/21	60/37	45/37	53/37
Hansen test **Arellano-Bond test of AR(1) in first differences** **Arellano-Bond test of AR(2) in first differences**	Chi2(17) = 31.85 p=0.10 z=-0.88, p=0.38 z= -0.71, p=0.48	Chi2(33) = 43.84 p=0.23 z= -2.56, p=0.01 z= -0.90, p=0.37	Chi2(33) = 39.34 p=0.21 z=-0.26, p=0.80 z= -0.02, p=0.99	Chi2(33) = 40.91 p=0.162 z=-1.89, p=0.06 z=-1.88, p=0.06

5 Discussion and concluding remarks

The paper investigates the empirical relationship between informality and trade liberalization using three different measures of the informal sector (and four different indicators of trade liberalization). One measure of informality is retrieved from household surveys instigated by ILO and reflects informal employment as a share of total employment. The other two – the macro-eclectic and Schneider (2007) measures – are macro-founded and identify informal output as a share of formal output. Empirical results suggest a mixed picture of the relationship between trade liberalization and informality.

Cross-sectional and time series properties of data appear to contrast with each other. However, in a dynamic panel estimation set-up that accounts for endogeneity, informal *employment* is found to decrease with deeper trade liberalization and informal *output* is found to increase with deeper trade liberalization. No existing theoretical framework is able to replicate these empirical findings. Indeed, the sign of the relationship is the same for any dimension of informality in all models. Both informal output and employment either increase or decrease with deeper trade liberalization.

Our empirical results may suggest that productivity in the informal sector increases after trade liberalization. Such an outcome is consistent with a situation where only the most productive informal firms remain active and even extend production after trade liberalization.[13] Assuming for a moment that informal output is produced exclusively by self-employed individuals, this would be consistent with the fact that the least productive individuals move to the formal sector where new and comparatively better employment opportunities have arisen because of trade liberalization. As the skills necessary to produce and survive in the informal sector are not necessarily those needed for employment in the formal sector, formal jobs could be thought of as homogeneous in skills requirements without any loss of generality. Improved formal employment opportunities after trade liberalization could be obtained in models with heterogeneity in formal firms' productivity. In these types of models the least productive firms are forced to stop production, but any associated loss in production and employment would be more than compensated by the expansion of exporting firms that enjoy lower trade costs (and/or cheaper inputs). Overall, formal employment and output would rise, informal employment would fall, but informal output could rise and the informal share in GDP may also rise.

However, time series analyses and existing empirical evidence at the firm level also suggest that the impact of trade liberalization is country- and industry-specific. Policymakers should therefore pay attention to factors that constrain resource reallocation not only across industries within the formal sector, but also from the informal to the formal sector. For instance, workers who are initially informal should be able to take up any job opportunity in the formal sector without any legal penalty. Or, they should be given the opportunity to fully reintegrate into the welfare system.[14] In addition, policymakers would also have to facilitate access to capital (either directly or indirectly) for firms/individuals

[13] This could be observed even with a rationed access to capital, as long as labour hoarding remains possible and returns to capital are not too decreasing.

[14] Fugazza and Jacques (2004) show that improved access to welfare benefits affects positively the willingness of informal workers to search for a job in the formal sector.

operating in the informal sector. The latter approach has often been presented as an important step towards the formalization of informal activities.[15]

This paper contributes to qualifying, at least empirically, the relationship between the informal sector and the degree of trade liberalization prevailing in an economy. However, further attention – whether theoretical or empirical – should be devoted to this, as it is also a key feature in appreciating the relationship between poverty and trade.

[15] See, for instance, Tokman (2001) and the references therein.

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Appendix 1: Country listings

Table A1. Countries in ILO and macro-eclectic data sets

ILO	Macro-eclectic approach	
Algeria	Algeria	Portugal
Argentina	Argentina	Republic of Korea
Australia	Australia	Senegal
Austria	Austria	Singapore
Bolivia (Plurinational State of)	Bangladesh	South Africa
Brazil	Belgium	Spain
Canada	Benin	Sri Lanka
Chile	Bolivia (Plurinational State of)	Sweden
Colombia	Brazil	Switzerland
Costa Rica	Cameroon	Syrian Arab Republic
Dominican Republic	Canada	Thailand
Ecuador	Chile	United Kingdom
Finland	China	United States
Honduras	China, Hong Kong	Uruguay
Hungary	Colombia	Venezuela (Bolivarian Republic of)
Indonesia	Costa Rica	Zambia
Israel	Côte d'Ivoire	Zimbabwe
Japan	Denmark	
Malaysia	Dominican Republic	
Mexico	Ecuador	
Morocco	Egypt	
New Zealand	Finland	
Norway	France	
Pakistan	Germany	
Panama	Ghana	
Peru	Greece	
Philippines	Guatemala	
Singapore	Honduras	
Sri Lanka	Hungary	
Sweden	India	
Switzerland	Indonesia	
Thailand	Ireland	
	Israel	
	Italy	
	Japan	
	Kenya	
	Malaysia	
	Mexico	
	Morocco	
	Nepal	
	Netherlands	
	New Zealand	
	Nicaragua	
	Nigeria	
	Norway	
	Pakistan	
	Panama	
	Peru	
	Philippines	

Table A2. ILO data set, country-year coverage

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Algeria												X	X	X	X	4
Argentina							X	X	X	X	X	X	X	X	X	9
Australia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	15
Austria					X	X	X	X	X	X	X	X	X	X	X	11
Bolivia (Plurinational State of)	X	X	X	X	X	X	X	X	X	X	X					11
Brazil												X	X	X	X	4
Canada	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	15
Chile							X	X	X	X	X	X	X	X	X	9
Colombia			X	X	X	X	X	X	X	X	X	X	X	X	X	13
Costa Rica	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	15
Dominican Republic							X	X	X	X	X	X	X	X	X	9
Ecuador	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	15
Finland	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	15
Honduras							X	X	X	X	X	X	X	X	X	9
Hungary			X	X	X	X	X	X	X	X	X	X	X	X	X	13
Indonesia														X	X	2
Israel						X	X	X	X	X	X	X	X	X	X	10
Japan	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	15
Malaysia						X	X	X	X	X	X	X	X	X		9
Mexico		X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
Morocco													X	X	X	3
New Zealand		X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
Norway							X	X	X	X	X	X	X	X	X	9
Pakistan						X	X	X	X	X	X	X	X	X	X	10
Panama		X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
Peru													X	X	X	3
Philippines												X	X	X	X	4
Singapore		X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
Sri Lanka													X	X	X	3
Sweden	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	15
Switzerland		X	X	X	X	X	X	X	X	X	X	X	X	X	X	14
Thailand	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	15
Total	**9**	**14**	**16**	**16**	**17**	**20**	**25**	**25**	**25**	**25**	**25**	**27**	**30**	**31**	**30**	**335**

Appendix 2: Informality measures

Table A3. Cross-sectional correlation, levels, selected years

	ILO	**Macro-eclectic**	**Schneider (2007)**
ILO	1		
Macro-eclectic	1990: 0.664* (9) 1995: 0.675*** (20) 2000: 0.759*** (25) 2004: 0.682*** (30)	1	
Schneider (2007)	1990: 0.802*** (9) 1995: 0.700*** (20) 2000: 0.759*** (25) 2004: 0.712*** (30)	1990: 0.918*** (66) 1995: 0.951*** (66) 2000: 0.990*** (66) 2004: 0.988*** (66)	1

Note: ***, **, and * mean significant at the 1 per cent, 5 per cent and 10 per cent level.
The number of observations used to calculate the correlation coefficients is in brackets.

Table A4. Cross-sectional correlation, first differences, selected years

	Info_ILO	Info_Macro	Info_S
Info_ILO	1		
Info_Macro	1990–1995: 0.615* (8) 1995–2000: -0.186 (19) 2000–2004: 0.036 (22) 1990–2004 : -0.05 (7)	1	
Info_S	1990–1995: 0.684* (8) 1995–2000: 0.466** (19) 2000–2004: 0.386* (22) 1990–2004 : 0.470 (7)	1990–1995: 0.134 (66) 1995–2000: 0.324*** (66) 2000–2004: 0.215* (66) 1990–2004 : 0.557*** (66)	1

Note: ***, **, and * mean significant at the 1 per cent, 5 per cent and 10 per cent level.
The number of observations used to calculate the correlation coefficients is in brackets.

Figure A1. Info_ILO versus Info_Macro (all years)

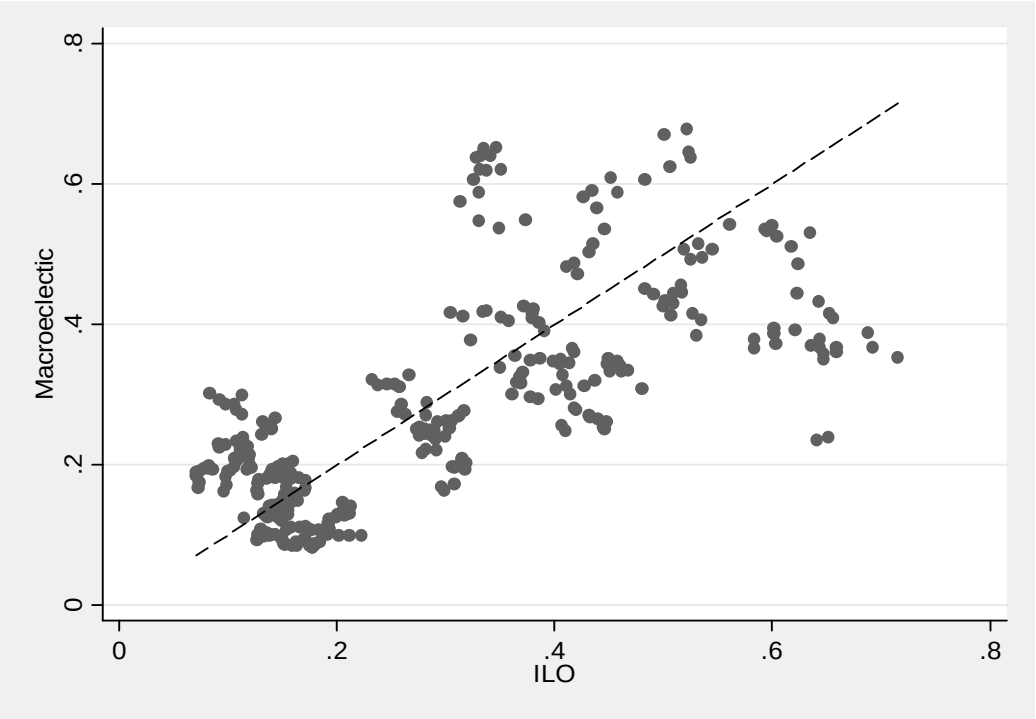


Figure A2. Info_ILO versus Info_Macro (mean)

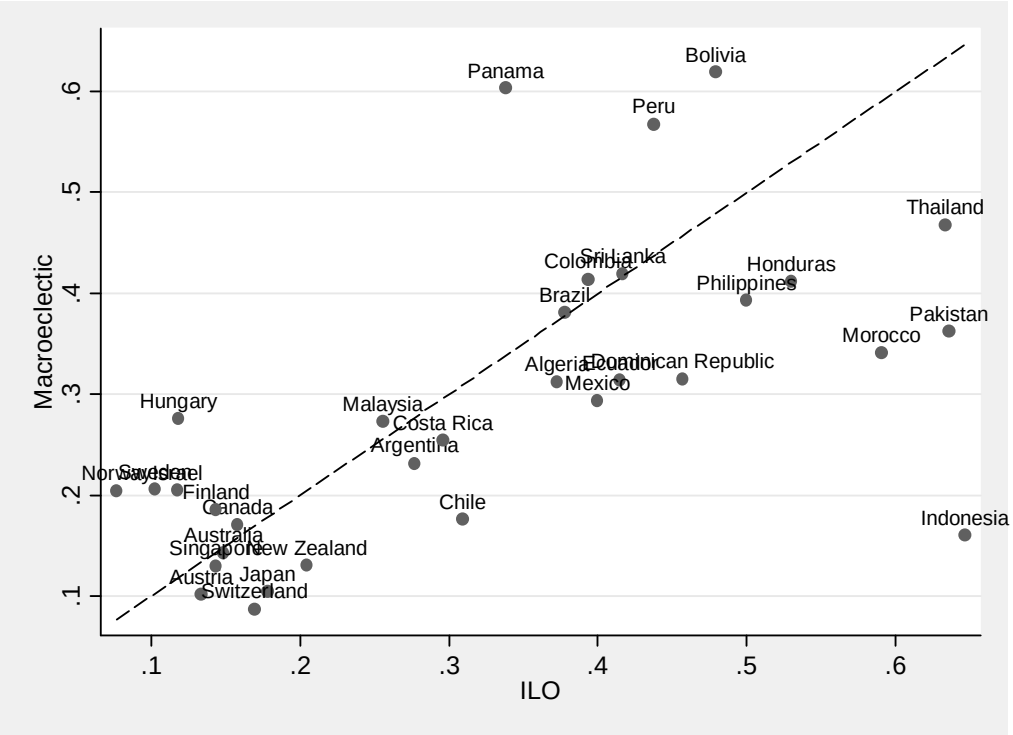


Table A5. Cointegration analysis between Info_ILO and Info_Macro

	Cointegration rank	Trace test	Simulated c.v.	
Argentina	r = 0	5.22*	15.93	
	r = 1	0.49	7.36	
Australia	r = 0	18.97	15.93	coint.
	r = 1	2.84*	7.36	
Austria	r = 0	2.98*	15.93	
	r = 1	0.42	7.36	
Bangladesh	r = 0	16.04	15.93	coint.
	r = 1	1.52*	7.36	
Canada	r = 0	19.64	15.93	coint.
	r = 1	4.75*	7.36	
Chile	r = 0	17.11	15.93	coint.
	r = 1	0.66*	7.36	
Colombia	r = 0	16.19	15.93	coint.
	r = 1	0.31*	7.36	
Costa Rica	r = 0	16.35	15.93	coint.
	r = 1	0.26*	7.36	
Dominican Republic	r = 0	7.19*	15.93	
	r = 1	0.02	7.36	
Ecuador	r = 0	17.80	15.93	coint.
	r = 1	3.85*	7.36	
Finland	r = 0	16.47	15.93	coint.
	r = 1	0.00*	7.36	
Honduras	r = 0	16.14	15.93	coint.
	r = 1	2.49*	7.36	
Hungary	r = 0	8.50*	15.93	
	r = 1	1.36	7.36	
Israel	r = 0	11.95*	15.93	
	r = 1	0.00	7.36	
Japan	r = 0	20.72	15.93	coint.
	r = 1	2.37*	7.36	
New Zealand	r = 0	16.14	15.93	coint.
	r = 1	0.67*	7.36	
Norway	r = 0	17.85	15.93	coint.
	r = 1	2.74*	7.36	
Pakistan	r = 0	7.30*	15.93	
	r = 1	0.53	7.36	
Panama	r = 0	23.33	15.93	coint.
	r = 1	4.43*	7.36	
Singapore	r = 0	25.02	15.93	coint.
	r = 1	1.37*	7.36	
Sweden	r = 0	17.35	15.93	coint.
	r = 1	0.01*	7.36	
Switzerland	r = 0	18.58	15.93	coint.
	r = 1	3.46*	7.36	
Thailand	r = 0	11.33*	15.93	
	r = 1	2.11	7.36	

Notes: The Johansen (1988) trace test examines whether there is cointegration between the ILO measure of informality and the informality measure derived from the macro-eclectic approach. The null of cointegrating vectors is given by *r*. The model is selected on the basis of a model reduction procedure and residuals are reasonably well specified. To account for a potential small sample bias, critical values are simulated for N=14 and a Bartlett correction from Johansen (2002) is applied. Star (*) indicates that we reject the null of cointegration.

Appendix 3: Cross-sectional analysis

Figure A3. Info_ILO and alternative trade openness measures

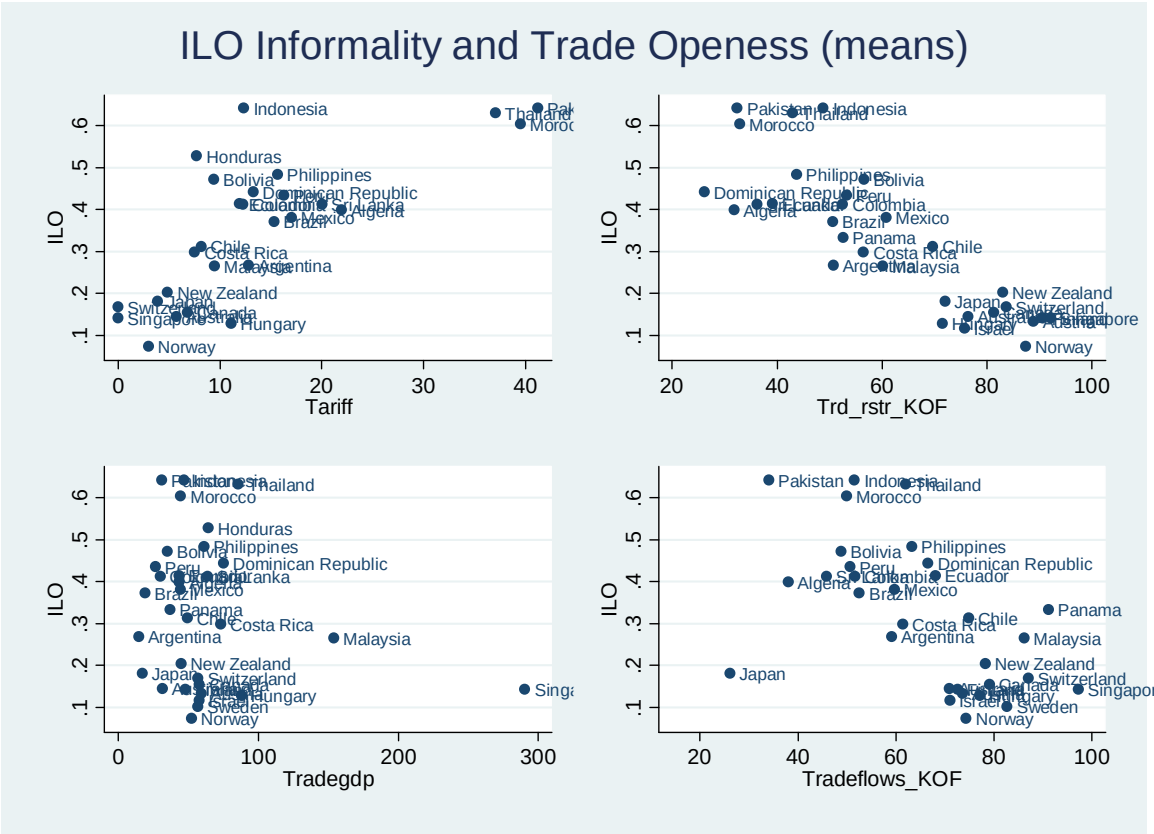


Figure A4. Info_Macro and alternative trade openness measures

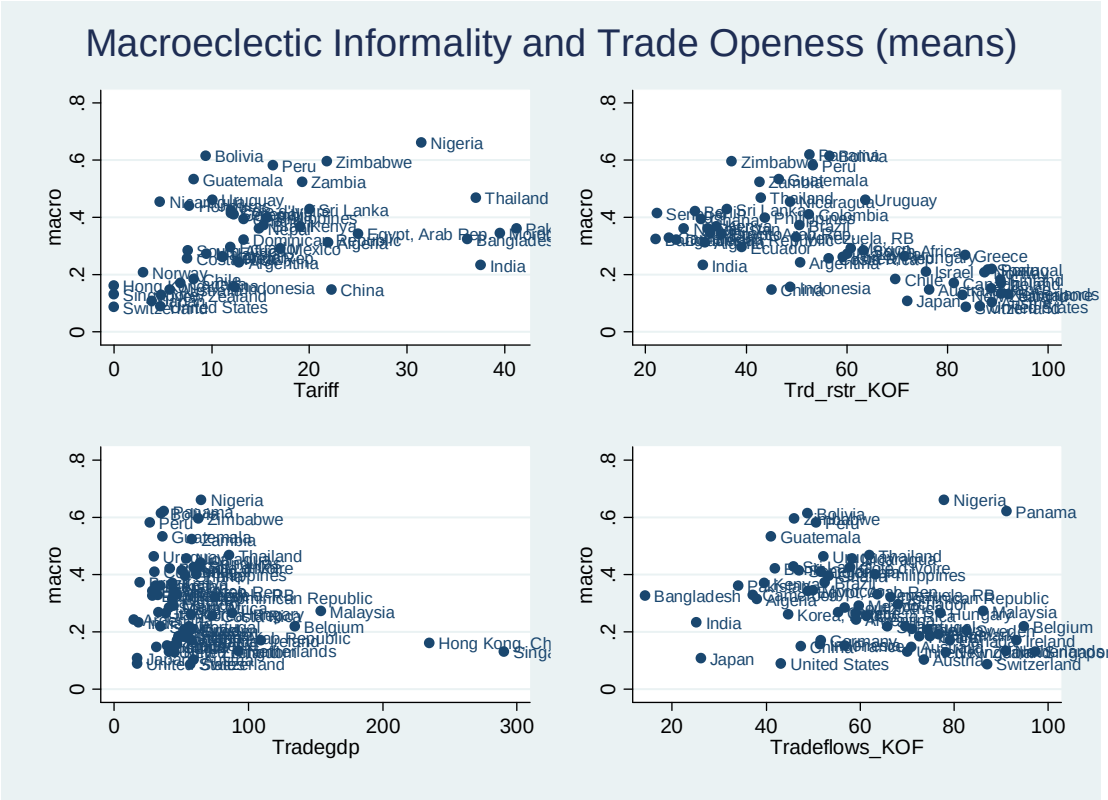
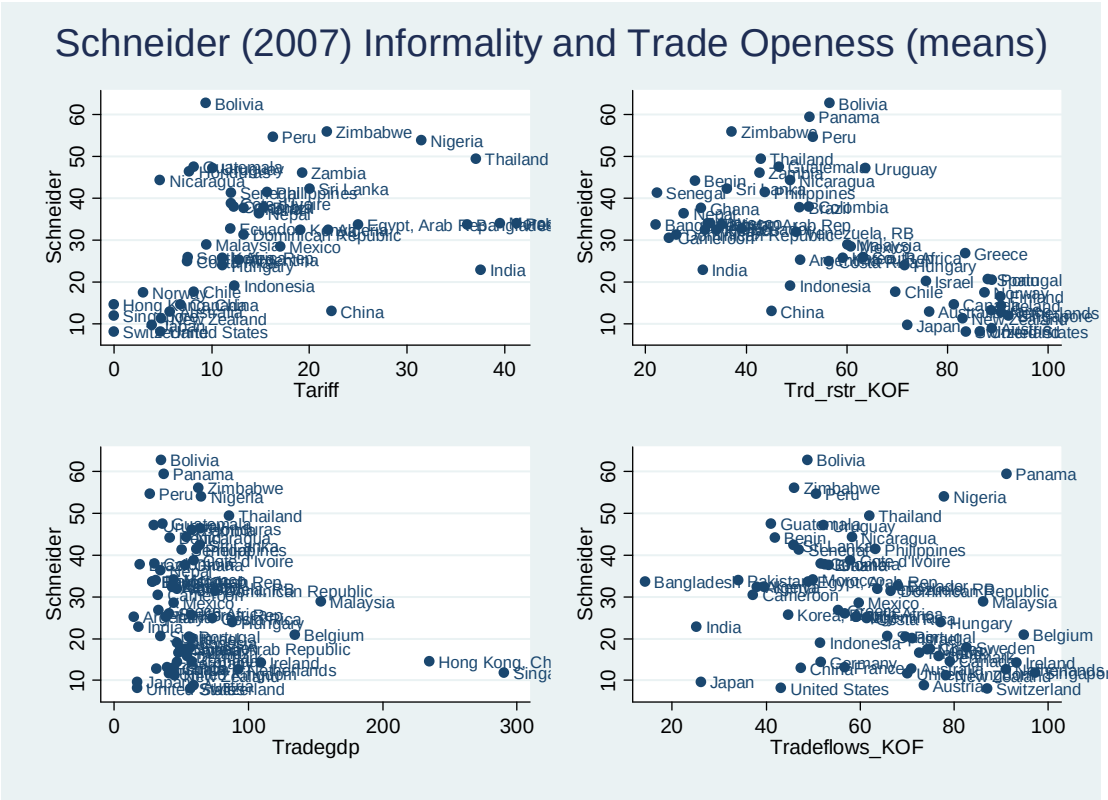


Figure A5. Info_S and alternative trade openness measures



Appendix 4: Cointegration analysis

Table A6. Cointegration analysis of informality and trade openness

Region	Country	Info_Macro, Trade/GDP	Standard errors	p-value	Info_ILO, Trade/GDP	Standard errors	p-value
Africa							
	Benin	0.0179	0.0037	0.00			
	Cameroon	-0.0067	0.0022	0.00			
	Côte d'Ivoire	-0.0040	0.0007	0.00			
	Ghana	0.0036	0.0018	0.05			
	Kenya	0.0067	0.0027	0.01			
	Nigeria	0.0254	0.0128	0.05			
	Senegal	-0.0112	0.0040	0.01			
	South Africa	-0.0027	0.0008	0.00			
	Zambia						
	Zimbabwe	-0.0183	0.0070	0.01			
East Asia and Pacific							
	China	-0.0013	0.0007	0.06			
	Indonesia	0.0287	0.0034	0.00			
	Malaysia	-0.0525	0.0102	0.00	-0.3992	0.1111	0.00
	Philippines	-0.0113	0.0017	0.00	-0.0647	0.0026	0.00
	Thailand	-0.0102	0.0023	0.00	0.0044	0.0015	0.00
Latin America							
	Argentina	-0.0045	0.0011	0.00	0.0020	0.0002	0.00
	Bolivia (Plurinational State of)	0.0194	0.0060	0.00	0.0375	0.0074	0.00
	Brazil	-0.0017	0.0004	0.00			
	Chile	-0.0033	0.0002	0.00	-0.0012	0.0002	0.00
	Colombia	0.0007	0.0004	0.09	-0.0080	0.0016	0.00
	Costa Rica	-0.0017	0.0007	0.02	-0.0019	0.0008	0.02
	Dominican Republic	-0.0046	0.0014	0.00			
	Ecuador	-0.0039	0.0005	0.00	0.0009	0.0003	0.00
	Guatemala	-0.0446	0.0224	0.05			
	Honduras						
	Mexico	-0.0031	0.0003	0.00	0.0059	0.0017	0.00
	Nicaragua	-0.0021	0.0005	0.00			
	Panama	-0.0455	0.0131	0.00	0.0021	0.0012	0.07
	Peru	-0.0053	0.0029	0.06			
	Uruguay	-0.0037	0.0013	0.01			
	Venezuela (Bolivarian Republic of)	-0.0243	0.0039	0.00			

/…

(Table A6. cont'd.)

Region	Country	ILO_Macro, Trade/GDP	Standard errors	p-value	Info_ILO, Trade/GDP	Standard errors	p-value
Middle East and Northern Africa							
	Algeria	-0.0066	0.0006	0.00			
	Egypt	-0.0633	0.0206	0.00			
	Morocco	-0.0077	0.0045	0.09			
South Asia							
	Bangladesh	-0.0086	0.0024	0.00			
	India	0.0027	0.0007	0.00			
	Pakistan	-0.0752	0.0195	0.00	-0.0068	0.0035	0.05
	Sri Lanka	-0.0416	0.0119	0.00			
High-income							
	Australia	0.0011	0.0003	0.00	0.0036	0.0007	0.00
	Austria	-0.0001	0.0001	0.11	0.0006	0.0000	0.00
	Belgium	0.0026	0.0012	0.03			
	Canada	0.0102	0.0022	0.00	-0.0016	0.0003	0.00
	Denmark	0.0009	0.0006	0.15			
	Finland	0.0015	0.0004	0.00	0.0017	0.0004	0.00
	France	-0.0007	0.0002	0.01			
	Germany	0.0002	0.0001	0.05			
	Greece	-0.0017	0.0012	0.14			
	Ireland	0.0096	0.0012	0.00			
	Italy	-0.0017	0.0003	0.00			
	Japan	0.0012	0.0003	0.00	0.0062	0.0016	0.00
	Netherlands	-0.0004	0.0003	0.14			
	New Zealand	0.0084	0.0013	0.00	-0.0240	0.0086	0.01
	Norway	-0.0102	0.0016	0.00	-0.0054	0.0015	0.00
	Portugal	-0.0019	0.0005	0.00			
	Spain	-0.0018	0.0002	0.00			
	Sweden	0.0028	0.0005	0.00	0.0074	0.0014	0.00
	Switzerland	-0.0002	0.0001	0.10	-0.0019	0.0003	0.00
	United Kingdom	0.0033	0.0010	0.00			
	United States	0.0012	0.0003	0.00			
High-income, other							
	Israel	-0.0025	0.0004	0.00	0.0003	0.0000	0.00
	Republic of Korea	-0.0034	0.0008	0.00			
	Singapore	-0.0034	0.0015	0.03	-0.0090	0.0028	0.00

Note: Coefficient estimates of Johansen cointegration regression of data vector consisting of informality and trade openness. Coefficients are in vector form and normalized on informality variable (not reported). A positive coefficient implies that greater trade openness leads to an increase in informality; a negative coefficient indicates that trade liberalization leads to a reduction in informality.

Table A7. Cointegration analysis between informality and trade restrictions

Region	Country	Info_Macro, trade restrictions	Standard errors	p-value	Info_ILO, trade restrictions	Standard errors	p-value
Africa							
	Benin	-0.0220	0.0027	0.00			
	Cameroon	-0.01586	0.00943	0.09			
	Ghana	0.0108	0.0020	0.00			
	Kenya	-0.0023	0.0009	0.01			
	Senegal	-0.0091	0.0018	0.00			
	South Africa	-0.00368	0.00148	0.01			
	Zambia	0.0016	0.0009	0.08			
	Zimbabwe	0.0218	0.0057	0.00			
East Asia and Pacific							
	China	0.0076	0.0024	0.00			
	Indonesia	-0.0035	0.0005	0.00			
	Malaysia	-0.0109	0.0015	0.00	0.0044	0.0003	0.00
	Philippines	-0.0073	0.0012	0.00			
	Thailand	-0.0108	0.0007	0.00	0.0058	0.0011	0.00
Europe and Central Asia							
	Hungary	0.0044	0.0011	0.00	-0.0044	0.0007	0.00
Latin America and Caribbean							
	Argentina	0.0032	0.0010	0.00	-0.0007	0.0003	0.03
	Bolivia (Plurinational State of)	-0.0118	0.0010	0.00	-0.0361	0.0063	0.00
	Brazil	0.0017	0.0006	0.01			
	Chile	-0.0034	0.0006	0.00	-0.0011	0.0003	0.00
	Colombia	-0.0405	0.0025	0.02	-0.0530	0.0201	0.01
	Costa Rica	-0.0003	0.0002	0.08	-0.0010	0.0004	0.01
	Dominican Republic	-0.0050	0.0011	0.00			
	Ecuador	-0.0016	0.0008	0.03	0.0394	0.0079	0.00
	Guatemala	-0.0158	0.0035	0.00			
	Honduras						
	Mexico	0.0131	0.0053	0.02	-0.0223	0.0069	0.00
	Nicaragua	-0.0006	0.0002	0.01			
	Panama	-0.0057	0.0008	0.00	-0.0012	0.0005	0.01
	Peru	0.0300	0.0108	0.01			
	Uruguay	-0.0049	0.0023	0.03			
	Venezuela (Bolivarian Republic of)	-0.0057	0.0028	0.04			

/…

(Table A7. cont'd.)

Region	Country	Info_Macro, trade restrictions	Standard errors	p-value	Info_ILO, trade restrictions	Standard errors	p-value
Middle East and North Africa							
	Algeria	-0.0076	0.0013	0.00	0.0041	0.0022	0.07
	Egypt	0.0142	0.0045	0.00			
	Morocco	-0.0558	0.0246	0.02			
South Asia							
	Bangladesh	-0.0047	0.0012	0.00			
	India	0.0036	0.0010	0.00			
	Nepal	-0.0166	0.0067	0.01			
	Pakistan	-0.0019	0.0006	0.00	0.0020	0.0002	0.00
	Sri Lanka	-0.0032	0.0003	0.00			
High-income							
	Australia	0.0010	0.0001	0.00	0.0044	0.0006	0.00
	Austria	-0.0002	0.0001	0.05	-0.0056	0.0015	0.00
	Canada	0.0031	0.0003	0.00	0.0011	0.0005	0.04
	Finland	0.0153	0.0034	0.00	0.003793	0.000783	0
	France	-0.00108	0.00034	0.01			
	Greece	-0.0020	0.0004	0.00			
	Ireland	0.0104	0.0026	0.00			
	Japan	-0.0009	0.0003	0.00	0.0022	0.0005	0.00
	Netherlands	-0.0009	0.0004	0.02			
	New Zealand	0.0023	0.0005	0.00	0.0036	0.0011	0.00
	Norway	-0.0083	0.0029	0.00	-0.0028	0.0003	0.00
	Portugal	-0.0168	0.0051	0.00			
	Spain	-0.0097	0.0014	0.00			
	Switzerland	-0.0006	0.0003	0.05	-0.0087	0.0027	0.00
	United States	0.0065	0.0006	0.00			
High-income, other							
	Israel	-0.0022	0.0001	0.00	0.0004	0.0001	0.00
	Republic of Korea	-0.0125	0.0013	0.00			
	Singapore	0.0036	0.0014	0.01	0.0089	0.0045	0.05

Note: Coefficient estimates of Johansen cointegration regression of data vector consisting of informality and trade restrictions. Coefficients are in vector form and normalized on informality variable (not reported). A positive coefficient implies that a lower level of restrictions on trade (e.g. lower import tariffs) leads to a reduction in informality; a negative coefficient indicates that trade liberalization leads to a higher level of informality.

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