Is Informality a Barrier to Sustainable Development?

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Abstract

In this paper, using a novel, annual cross-country panel dataset that covers 160 economies from 1950 to 2016, we examine the association between the size of the informal sector and various indicators of sustainable development. The range of indicators encompasses health-related, economic, environmental, education, and social variables. Our results suggest that the size of the informal sector is negatively associated with GDP per capita, carbon dioxide emissions per capita, education, educational attainment, life expectancy, and access to safe drinking water, and positively related to female labor force participation rate, poverty rates, mortality rates, and air pollution. We also find that these empirical associations significantly interact with GDP per capita, indicating that the effect of larger informal sector size is stronger in less developed economies.

Key Words: Informality; economic development; inequality; sustainability; feminization of labor.

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1. Introduction

In this study, we consider how the informal sector affects the achievement of sustainable development goals. Sustainable development has been a central theme in development economics since the 1980s, especially after the United Nations (UN) World Commission on Environment and Development published its *Our Common Future* report in 1987 (Lèlè, 1991; Hopwood et al., 2005). This report, also known as the Brundtland Report, focused on "safeguarding long-term ecological sustainability," "satisfying basic human needs," and "promoting inter- and intragenerational equity" (Holden et al., 2014, pp. 131–132). Sustainable development stands on three interdependent pillars—namely, the economic, social, and environmental dimensions of development and how they affect current and future generations. In 2015, the UN General Assembly ratified a set of Sustainable Development Goals (SDGs) for the year 2020.

The livelihood of poor people in developing countries often depends critically on informal economic activity. The informal sector accounts for about 70 percent of employment in a typical developing economy. Moreover, informal economic output has been estimated at some 35 percent of the total GDP in developing economies compared with about 15 percent of GDP in advanced economies (World Bank, 2019). Although it offers the advantage of flexible employment in some circumstances, informality is also associated with a wide range of adverse economic outcomes, including low productivity, limited fiscal resources, poverty, and income inequality. As such, informality is a crucial consideration in policy decisions that aim to advance sustainable development. Informality is a ubiquitous phenomenon in all economies. Nevertheless, economists have not reached a clear consensus on its implications, and many issues related to its nature and consequences remain inadequately explored.

There is a growing literature on the impact of the informal economy as measured by various economic and social variables. Most of these studies have adopted a microeconometric approach, focusing on a single country or a single occupation group. Generally, they aim to understand the effect of informality on a handful of variables, such as particular occupational health and safety outcomes or carbon dioxide emission production. In contrast, in this paper we take a macro approach by drawing on the most comprehensive datasets in existence on the informal economy, covering 160 countries over the period from 1950 to 2016.[4] Moreover, to the best of our knowledge, ours is the first paper to examine the relationship between such a broad range of dimensions of sustainable development, encompassing numerous economic, social, environmental, education, and health-related variables, and informality. Our study uses the indicators of the sustainable development goals (SDG) as a proxy for assessing different components of economic development for a panel of countries. Therefore, this study solely focuses on the impacts, not causes, of informal economy.

After a brief literature review this paper provides comprehensive empirical evidence on the heretofore unresolved relationship between economic informality and sustainable development goals. Overall, our empirical results show the detrimental effect of economic informality on sustainable development indicators. Specifically, we find that the size of the informal sector is negatively associated with GDP per capita, CO_2 emissions per capita, school attendance rates, educational attainment, life expectancy and access to safe drinking water and positively associated with the female labor force participation rate, poverty rates, mortality rates, and air pollution. Our findings suggest that the informal sector's overall detrimental impact lessens with increased levels of economic development.

[4] See *inter alia* Goel and Nelson (2016) and Elgin (2020) for comprehensive works on the determinants of the informal economy.

The next section reviews the literature on the relationship between the informal economy and income inequality, poverty, the feminization of labor, and some environmental and health indicators. In section 3, we introduce the data and empirical methods. Section 4 presents the estimation results, and our concluding section summarizes the findings.

2. Literature Review

There are several interpretations and definitions of sustainable development.[5] The notion of economic development includes transforming production, creating high value-added industries, high and stable employment, and an adequate supply of social and public good sustainably, and it should also address the urgent problems of income, gender, and racial inequalities as well as the climate change (Benería et al., 2016: 224, 231). The SDG indicators can shed light on various aspects of these economic and social issues, even though there are important criticisms against the SDGs as economic policy tools. Based on these insights, this section has two main parts. First, we briefly discuss the main critiques of the SDGs and sustainable development. Then, we review the literature on the relationship between the informal economy and the main social, economic, and environmental indicators.

Higher economic growth under the neoliberal paradigm has come with increasing inequality, promotion of consumerism and conspicuous consumption, environmental degradation and global warming, and erosion of democracy (Stern et al., 1996; Khan, 2015; Benería et al., 2016; Galbraith, 2016; Milanovic, 2016). Both the Millennium Development Goals (MDGs) in 2000 and the Sustainable Development Goals (SDGs) in 2012 aimed to address some of these challenges. However, there have been important critiques of these initiatives. For example, Chang (2011) argues that the nature of these programs' economic strategies are non-developmental, even

[5] See Carvalho (2001), Hopwood et al. (2005), Kallio et al. (2007) and Kambites (2012) for a comprehensive discussion.

anti-development, as these initiatives do not address how the transformation of the production structure takes place and assume that a liberal trade regime is sufficient for achieving development goals. Benería et al. (2016) go further to argue that these initiatives "have served to avoid the needed social change and transformation" (p. 230). Thus, the main criticism against the SDGs is that they will fail without the transformation of the existing economic paradigm, which has created the economic, social, and environmental problems that the SDGs aim to eradicate (Carvalho 2001; Chang, 2011; Benería et al., 2016; Pogge & Sengupta, 2016; Harangozo et al., 2017).

The mainstream economic paradigm prioritizes the economy over society and the environment, and it fails to acknowledge and appreciate the human and natural dimensions of the economy (Griethuysen 2002). However, it is crucial to recognize that the economy is nested in society to serve society, and society depends on the environment (Baumgartner and Korhonen, 2010). Without acknowledging 'society within a biosphere,' the mainstream paradigm becomes an obstacle for sustainable development as it merely sees the environment and society are resources to exploit (Giddings et al. 2002).

The neoliberal paradigm has exacerbated the environmental disruption and social inequalities between countries and led to an unsustainable development path. In this regard, Griethuysen (2002) argues that evolutionary economics is a better approach to understand the dynamics of economic development in its eco-social sense. The evolutionary economic approach sees the economy as a set of self-organizing systems instead of self-correcting mechanisms. A tangential aspect of this understanding is to acknowledge that sustainable development is based on the integration of the economic, environmental, and social dimensions. The institutional dimension is not independent of an economic one but a product of it.

Therefore, it is argued that what we need is 'transformative politics.' Reaching the 'good society,' which should be the end goal instead of 'development,' requires a shift from focusing on the economy to society, and reform in governance to regulate the economic growth in a way not to compromise the main elements of good society, namely equity, sustainability, and social justice (Khan 2015). A related question is if such a transformative development agenda can be achieved without the transformation of profit-motivated business. Scheyvens et al. (2016) argue that to reach the sustainability goals, we should overcome the neoliberal agenda that determine how business and society operate. Similarly, socially responsible investments sound naïve in the current economic predatory capitalism, which does not allow government intervention to promote socially, environmentally, culturally, and morally sustaining economic growth (Scholtens et al. 2008; Khan 2015). In this sense, fiscal policy, particularly tax policy, is one key issue to answer if environmentally and socially sustainable economic growth is possible (Lopez and Figueroa 2016).[6]

Therefore, the brief discussion above suggests that the current economic system, neoliberal paradigm, is the root cause of the unsustainable path. The informalization of the labor market has increased in the neoliberal era (Benería et al., 2016, p. 151). This informalization, on the one hand, has exacerbated the economic and social problems of this unsustainable path. On the other hand, as sound literature suggests, higher informality is associated with lower levels of productivity and wages, investment, and, thereby, economic growth, which is likely to reinforce the informality (Rada & von Arnim, 2014). Alternatively, the shift of labor from low productive, informal sectors,

[6] In this context, it is worth mentioning the debates on the indispensability of growth, namely degrowth, the zero-growth, and the green new deal (Harangozo et al., 2017). The origin of degrowth goes back to one of the Brundtland Commission's main principles that are about accepting limits, requiring a decline in consumption, which will reduce environmental degradation (Springett 2013).

to highly productive ones can contribute to economic growth. The shift of labor into these sectors raises wages and aggregate demand, which in turn lead to economic growth and Kaldor–Verdoorn type productivity growth; such changes also increase human capital and reduce the developing countries' dependence on the developed countries' goods and financial services (Rada & von Arnim 2014, p.2). However, the prevalence of informality traps the labor in low productivity/wage sectors and deprives the economy of the income growth that could promote sustainable growth and development.

Therefore, the informality plays a central role in economic growth through a rise in productivity because there is a significant gap between labor productivity in the formal and informal sectors (Rada, 2010). The UN Development Program estimates that the informal economy, on average, is responsible for one-third of GDP and more than 70 percent of employment in developing countries (World Bank, 2019, p. 130). Since a clear boundary between the formal and informal economies is not always easy to establish, discussions in the 1970s and 1980s focused on how to define informality, and specifically on "how to operationalize this definition for statistical and policy purposes" (Meagher, 2013, p. 2). The International Labour Organization (ILO) and Women in Informal Employment: Globalizing and Organizing (WIEGO) offered a more comprehensive, three-part understanding of economic informality: (1) the informal sector as "production and employment in unregistered enterprises," (2) informal employment as "employment outside of the labor protection regulations of a given society, whether in formal or informal firms," and (3) the informal economy, which "covers all firms, workers, and activities that operate outside the legal regulatory framework of society, and the output that they generate" (Meagher, 2013, p. 2).

Recently, many studies have considered the impact of economic informality on various socio-economic indicators. The prevalence of informality is widely seen as an economic trap in developing economies, as it is often described as resulting in a lower rate of productivity and output growth, less effective institutions, higher poverty, and income inequality (World Bank, 2019). Inadequate occupational health and safety (OHS) and environmental problems can also be added to this list of threats associated with the informal economy (Lund and Marriott, 2011; Brown et al., 2014). For these reasons, economic informality should be analyzed as a multilayered concept with important implications for economic growth, income and gender inequality, poverty, OHS, and environmental degradation. These layers place economic informality at the epicenter of sustainable development regardless of its positive or negative impacts.

There are three main views on the nexus of informality and economic growth; one group argues that there is a negative relationship between them, another group claiming a positive one, and according to a third one, the relationship depends on income level. According to the first argument, excessive regulation leads to informality; and informality is a common detriment to economic growth (Loayza, 1997; Sarte, 2000; Loayza et al., 2004). Furthermore, growth in the informal economy reduces government revenues available to finance major social investments in such areas as education, health, or infrastructure investment that could facilitate economic growth. A significant body of literature, including both macro-level (e.g. Loayza, 1997; Johnson et al., 1997) and micro-level studies (*inter alia* de Soto, 1989; Natarajan 2011) support this view. The second view argues that a larger informal sector can stimulate economic growth, because firms in the informal sector, employing lower-skilled workers, operate at a lower cost and capital level than those in the formal sector (Amaral and Quintin, 2006). Some researchers have reported higher productivity levels in the formal economy in countries with larger informal economies (D'Erasmo

& Boedo, 2011; Elgin & Birinci, 2016). A third view argues that the type of relationship between the size of the informal sector and economic growth depends on the income levels; i.e., the relationship is positive in high-income countries and low in low-income ones (Elgin & Birinci, 2016).

Economic informality is also seen as having a relationship with poverty, because most jobs in the informal sector are low-paid, irregular, and without any social benefits (ILO, 2013). However, this link is not very strongly established, due to large gray areas between the formal and informal sectors resulting from forward and backward linkages between formal and informal enterprises (Meagher, 2013; Brown et al., 2014). On one hand, one group, taking a rational, individualistic approach, argue that labor movements are not determined by regulatory incentives but rather by individuals who choose to exit the formal economy and its costly taxation—despite the greater social protection it offers—to maximize their income and flexibility (Jäckle & Li, 2006; Levenson & Maloney, 1998; Maloney, 2004; Perry et al., 2007, all cited in Meagher, 2013, p. 7). However, others have argued that workers do not generally opt out of the formal economy by choice and that formal-sector employers reap most of the benefit (Valodia, 2001; Altman, 2008; Valodia & Devey, 2010, all cited in Meagher, 2013, p. 8). In India, whereas some studies have suggested that such labor market linkages increased demand for informal workers without reducing their wages (e.g., Siggel, 2010), many others have argued that informal-sector workers suffered increased poverty (Arvin-Rad et al., 2010, Breman, 1996 & 2010, Harriss-White & Gooptu, 2001; Marjit & Maiti, 2006; Sinha & Adams, 2006, cited in Meagher, 2013). Related literature on the global value chains also shows more evidence of intensifying poverty and vulnerability within the informal sector (Meagher, 2013).

Another set of studies has focused on the effects of the informal economy on income distribution. There are several channels through which informalization of the labor market might affect income inequality (Schneider & Enste, 2000; Mishra & Ray, 2010; Dell'Anno, 2016); conversely, income equality can affect the size of the informal sector (Elgin & Elveren, 2019). It has often been argued that the presence of the informal sector improves income distribution by providing employment opportunities to low-skilled or unskilled workers and thus furnishing income to the poor and excluded groups. However, the informal sector can also distort income distribution by causing a decline in tax revenues that could be used to implement progressive redistribution policies. Furthermore, inequality impacts informality by decreasing the accumulation of human and physical capital and by increasing the demand for informal-sector products. A sizable literature has offered inconsistent findings on the relationship between income inequality and the size of the informal sector (Rosser et al., 2000, 2003; Ahmed et al., 2007; Dell'Anno, 2008; Amarante & Arim, 2017; Chong & Gradstein, 2007; Mishra & Ray, 2010; Elgin et al., 2020).[7]

Income gaps, which can intensify poverty and existing inequalities, frequently exist between the formal and informal sectors (World Bank, 2019, p. 152). In addition, another gap derives from economic exclusion on the basis of socio-economic differences (Meagher, 2015, p. 850) or by gender (Brown et al., 2014, p. 21). As a result, income and gender inequality usually increase in an economy as informal activities grow; gaps arise between limited formal and informal economies as well as within informal economies.

[7] In a recent comprehensive study, using annual cross-country panel data from 125 countries for the years 1963 to 2016, Elgin and Elveren (2019) showed that the relationship between the size of the informal sector and income inequality was more likely to be negative in richer countries and positive in poor ones. They also showed that the positive impact of higher female participation in the labor force on income distribution was canceled out by the presence of the informal sector.

A newer group of studies has focused on the relationship between informality, income gaps, and income or gender inequalities. For example, WIEGO developed its "multi-segmented model" based on existing literature and official statistics from the late 1990s (Chen, 2014, pp. 403–404). This multi-segmented model reflects a varying level of poverty risk as well as income and gender inequality, in a hierarchical order. The model demonstrates that employers, located at the top of the hierarchy, have the highest and most stable income; they are followed in order by regular informal workers, own-account operators, casual informal workers, those working at home, industrial outworkers, and finally unpaid family workers. This clear hierarchy of income and gender segmentation is well documented in the literature, based on official statistics (Chen, 2014, pp. 403–404; Brown et al., 2014, p. 12). As market reforms started to take place in developing countries in the 1980s, women were disproportionately employed in the informal sector while men mainly remained in the formal sector (Brown et al., 2014; Benería et al., 2016; Chant, 2013; ILO, 2018; Elgin & Elveren, 2019). In fact, as many as 92.1 percent of employed women in lower-income countries are informal workers (ILO, 2018, p. 20), and "informal employment tends to be a larger source of employment for women than for men in all developing regions except North Africa" (ILO, 2018, p. 115).

Factors related to supply and demand in the labor market also exacerbate gender inequality. Discrimination against women is a demand factor that pushes women into informal employment; such discrimination may arise due to women's maternity leave, their intermittent work life, or simply employers' bias against women. In terms of supply factors, women may prefer the informal sector for its flexibility so that they can coordinate paid employment with unpaid housework (Benería et al., 2016, Elgin & Elveren, 2019). As a result of these factors, women are more likely to be employed in the informal sector than men. Various social, cultural, economic, and political

factors reinforce this occupational segregation of women into the informal sector (Benería et al., 2016). The asymmetric burden of unpaid domestic work and childcare responsibilities (which fall heavily upon women), along with the frequent exclusion of women from education, is primarily responsible for the overrepresentation of females in informal employment. This occupational imbalance creates substantial disadvantages for women, leading to women's tendency to work fewer hours and earn less money than men. Since women undertake a greater proportion of unpaid care labor, they remain in full-time employment for less time than men. The informal sector also plays a role in decreasing female wages during their work years and therefore in retirement (Sabates-Wheeler & Kabeer, 2003). In sum, women's confinement to informal labor leads to income vulnerability, job insecurity, and relegation to the lower rungs of the labor market.

Poverty and increasing income inequality are significantly connected with inadequate education among informal workers and their children. Lack of public investment in childcare and education and the absence of redistributive policies worsen the already poor educational outcomes for informal workers and their children. This worsening leads to a vicious cycle as low-skill, and low-education levels are one of the primary reasons they cannot get a job in the formal sector. According to Bonnet et al. (2019), there is a clear correlation between informal employment and the education level. While the global rate of informal employment in 2016 is as high as 94 percent for those with no education, it drops to 85, 52, and 24 for percent among workers with primary education, secondary education, and tertiary education, respectively. Also, "among low-educated workers, women are more likely to be informally employed" (ibid, 19).

Montes et al. (2016) found overall that education increase the likelihood of discriminated groups to find a formal employment in Peru. Kolm and Larsen (2016) using a four-sector equilibrium search and matching model found for developed countries that informal employment

reduces the incentives of low-educated workers to acquire higher education. The authors noted that stricter enforcement policies increase educational incentives and create new jobs in the formal sector. However, such a policy strategy increases the actual unemployment rate because the number of jobs lost in the informal sector outweighs the jobs created in the formal sector.

Occupational health issues (OHS) related problems are another direct outcome of this occupational segregation. The literature suggests that the risk of work-related injuries and diseases is greater for workers in the informal sector, and these workers are also the least likely group to have adequate compensation that could help them afford the cost of health care (ILO, 2004). Intuitively, one can expect informal work settings to tend to bypass applicable safety regulations and to underreport work-related injuries. A large body of literature has shown a strong relationship between risky types of labor, including informal work, and the onset of dysfunctional behavioral, psychosocial, and physio-pathological pathways that can produce physical and mental health problems (Muntaner et al., 2010; Dike, 2019). For example, Da Silva et al. (2005, 2006) showed that ragpickers in Pelotas, Brazil were more likely than formal workers to be exposed to hazardous environmental and working conditions, causing various health problems including lower extremity pain. Based on different surveys, Aragon et al. (2011) and Lopez-Ruiz (2015) both contended that overall health conditions were significantly worse for informal workers in Central America than for those with formal employment. Ruiz et al. (2017), using data from Chile's first survey on employment, health, and quality of life (conducted in 2009–2010), found a significant association between informal employment and poor self-reported mental health. Loewenson (1998) showed higher rates of occupational risks for informal workers in Zimbabwe.

Informal work practices that bypasses safety regulations are also widespread in irregular jobs, where employees are predominantly female (Lund & Marriott 2011, p. 6). Women are more

likely to be exposed to such OHS problems, as they are disproportionately employed in monotonous, rapid-pace jobs "that require static postures and place static loads on muscles" (Lund & Marriott, 2011, p. 5). Similarly, Montero-Moraga et al. (2020) showed that female informal workers in Spain had poorer health status compared to a reference group, but that this difference disappeared after adjusting for psychosocial risk factors. Finally, a bidirectional causality between poverty and health has been noted. Intuitively, harsh living and a work environment that affords limited access to health care should worsen health conditions, leading in turn to a greater risk of poverty as health-related expenditures increase or available work time declines due to sickness. Therefore, one can expect that a larger informal sector is likely to increase both poverty and health problems, which reinforce each other in a vicious cycle.

The prevalence of informality can be a concern from an environmental perspective as well. Although some studies have viewed economic informality as a facilitator of a green economy in terms of waste management, agrifood markets, artisanal mining, use of biomass energy, and other practices (Benson et al., 2014), the environmental economics literature has shown that "environmental pollution depends on the intensity of government regulations" (Elgin & Oztunali, 2014, p. 334). In addition, in a well-documented global transformation, hazardous industries are shifting to developing countries with less environmental regulations (Lund and Marriott, 2014, p. 6). Baksi and Bose (2010) argued that the prevalence of a large informal sector poses a challenge to environmental regulations, and Elgin and Oztunali (2014, p. 334) highlighted the scale effects in which a larger informal economy leads to a higher level of environmental pollution.

Overall, most informal economic activities intensify environmental degradation by circumventing costly environmental regulations (Meagher, 2013; Benson et al., 2014; Brown et al., 2014; Goel et al., 2013). Benson et al. (2014) noted that because they remain out of reach of

environmental regulations and taxation, informal enterprises and markets are associated with higher levels of pollution and environmental degradation. Macro-level analyses have found a significant association between informal economic activity and higher levels of air pollution, as reported in case studies of developing Asian countries (Huynh, 2020), Peru (Swenson et al., 2011), Mexico (Blackman et al., 2006), and South Africa (Muchapondwa, 2010). In a comprehensive study covering 100 countries for the 2004-2007 period with special focus on the Middle East and North Africa (MENA), Goel et al. (2013) found that overall countries with a large informal economy have lower pollution levels; however, MENA countries are more polluting compared to large informal economies. They note that the finding is consistent with the fact that countries with a larger informal economy have a tendency not to report or to underreport the actual level of emissions.

The literature suggests that a larger informal economy also contributes to environmental degradation by intensifying urban poverty (Tacoli et al., 2008; Chen, 2008; McGranahan et al., 2001, cited in Brown et al., 2014). Population growth is often higher in urban areas due to migration, and economic informality tends to grow in urban areas if urbanization is not accompanied by sufficient growth in the modern industrial sector (Castells & Portes, 1989; Elgin & Oyvat, 2013; Meagher, 1995; Moser, 1978; cited in Brown et al., 2014, p. 12). Urban informality also tends to encourage the phenomenon of informal settlements or slums, which host one-seventh of the world's population. These areas suffer from the lack of decent sanitation services and facilities (Cohen, 2006) and their locations leave them highly exposed to climate-related hazards (Dodman et al., 2019).

In sum, the existing literature suggests that a larger informal sector causes urban poverty, which exposes informal workers, particularly women, to higher environmental hazards and high

rates of crime and violence. In turn, these factors contribute to lower life expectancy and/or to declines in other health indicators.

3. Data and Methods

3.1. Data

Several methods are frequently used in the literature to measure the size of the informal economy. In this paper, we use the updated version of a novel dataset measuring the size of the informal economy as a percentage of GDP, provided by Elgin et al. (2019), based on the two-sector dynamic general equilibrium (DGE) model constructed by Elgin and Öztunalı (2012). This method defines informality as a sector that produces legal goods and services but outside of government scrutiny (Ihrig and Moe, 2004; Elgin, 2020). The method simply relies on a country-by-country calibration of a two-sector (formal and informal) DGE model using national income statistics from the Penn World Tables 9.1 and then back out the informal sector size from the model's characterizing equation. One main advantage of this method is that one can construct a dataset for all countries and year available at the Penn World Tables. This unbalanced panel dataset covers 160 countries from the years 1950 to 2016. It considers how households allocate labor between formal and informal economies within each period and how the allocation changes over time. In comparison to other methods, the DGE approach stands out in its comprehensive country-year coverage, clear economic reasoning, and its applicability in policy experiments and projection (Loayza, 2016; Elgin, 2020). These estimates reflect several different dimensions of informality and are distinguished by their extent of coverage, constituting by far the largest dataset on informality and the only one that dates back to the 1950s. However, the time variation of the DGE estimates rely on several strong assumptions,[8] and therefore, for our robustness checks we also

[8] The DGE approach has some limitations. First, it strongly relies on assumptions. Second, like the MIMIC approach, it requires base-year estimates on the informal economy from another independent study to calibrate the size of

have used the estimates constructed by Medina and Schneider (2019) using the multiple indicators—multiple causes (MIMIC) method,[9] as well as data series on informal employment as a percentage of total non-agricultural employment,[10] albeit with a shorter time dimension, running from 1993 to 2016. For most of our reported results, we use the measure originating from the DGE method; however, to check for robustness we also provide some additional results[11] using the MIMIC measure.

Sustainable Development

In this study, we aim to assess the empirical association between informality and a broad spectrum of sustainable development indicators. We understand that the concept of sustainable development is hard to measure or to reduce to a few indicators. Accordingly, we include five different groups of sustainable development indicators: health-related, economic, environmental, education, and social variables. Each group contains several measures. We obtained the data series for all these variables from the World Development Indicators[12] (WDI).

The health-related group of variables includes life expectancy (in years at birth); infant mortality rate, neonatal mortality rate, and mortality under age five (all defined per 1,000 live births); maternal mortality per 100,000 live births; access to basic sanitation, safe drinking water, and basic drinking water (all three in percentage of total population); and immunization coverage

informal economy (Elgin and Oztunali 2012). Third, a computable DGE model only captures some of the stylized facts of the informal sector. Data availability, especially for developing economies, presents a challenge to matching DGE models with all aspects of informality.

[9] The MIMIC method relies on the estimation of a structural equation model where the informal sector is estimated as a latent variable that is determined by its causes and determines its indicators.

[10] See Elgin et al. (2019) for a comparison of these different series.

[11] Further results using measures other than the MIMIC are available upon request from the corresponding author.

[12] Moreover, we also recognize that none of the macroeconomic data series (a fraction of which is also used in this paper) is perfect; however, the source (WDI) aims to provide these series in a way that is consistent across a large cross-section of countries.

for DPT (percentage of children age 12 to 23 months) as well as for Hepatitis B (HepB3), defined as the percentage of immunized one-year-old children.

The economic variables group includes real GDP per capita (PPP, adjusted in constant 2011 international USD); three different poverty head-count ratio series at $5.50, $3.20, and $1.90 a day (defined at constant 2011 international prices); three poverty gap series, again at $5.50, $3.20, and $1.90 a day; and access to electricity (by percentage of population).

The group of environmental variables includes CO_2 emissions (in metric tons) per capita, CO_2 emissions per 2010 GDP (kg per 2010 US$ GDP), CO_2 emissions per 2011 PPP GDP (kg per 2011 PPP $ of GDP), air pollution (particles less than 2.5 microns, measured in micrograms per cubic meter), and mortality due to air pollution (per 100,000 people).

The educational variables group consists of tertiary schooling (overall percentage of the population), secondary schooling (overall percentage), adult literacy (percentage of literate people age 15 and above), both lower secondary and upper secondary educational attainment (percentage of the population age 25 and above who completed grades 8 and 12, respectively), and children not attending primary school (percentage of all children of primary school age).

Finally, the group of social variables includes teenage mothers (percentage of women age 15 to 19 who have had children or are currently pregnant), mortality by suicide (per 100,000 people), legal rights index (an index from 0 to 12, measuring the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders), adult literacy by gender (ratio of female adult literacy to overall adult literacy), female labor force participation (by the ILO's definition), female labor force participation (by national definitions), and a gender equality index (an index from 0 to 6 that assesses the extent to which the country has installed institutions and

programs to promote equal access for men and women in education, health, the economy, and legal protection).

Table 1 provides descriptive summary statistics for the complete dataset. In the table we also provide the acronyms that we are using in subsequent tables. As the table shows, the number of observations varies considerably across different variables. This is one reason why we need to use different estimation methods for the various sustainable development indicators. Nevertheless, the sizes of all series are large enough to allow us to run pooled cross-country or panel regressions.

Some Control Variables

In several of our regressions, we also use several control variables other than the informal sector or its interaction with GDP per capita. These include trade openness (defined as the ratio of the sum of exports and imports to GDP), growth of real GDP (by percentage), government spending (as a percentage of GDP), and unemployment (by percentage). Since our econometric model is not based on a structural theoretical model, in our analyses, we consider these major variables that are commonly used in the literature. Our *a priori* expectation for growth and government spending is that these variables will be positively correlated with the sustainable development indicators, whereas the correlation should be negative for unemployment.

As for the relationship between trade openness and sustainable development indicators, our expectations are mixed. Trade openness basically reflects the share of exports and imports in GDP, and an increase in trade volume may have a range of effects on socio-economic variables, depending on the institutions and other economic reforms and programs present in a given economy. However, we expect that higher trade volume will be associated with higher CO_2

production (Elgin & Oztunali, 2014). Also, trade openness is associated with higher female labor force participation in developing countries (Benería et al., 2016).

3.2. Methodology

Our full dataset is an annual cross-country panel, which is, for most variables, highly unbalanced. Further complicating the issue, several social and educational variables are available for only a few years. Thus, we cannot employ a single comprehensive econometric method for all the sustainable development indicators and choose the most appropriate one guided by several econometric tests.

Before proceeding with the regression results, we first ran two different unit root tests, namely the Fisher and the IPS tests, for each variable that has a sufficiently large time-series dimension. Our reason for choosing these two particular tests was that they are applicable to the highly unbalanced structure of our dataset. They indicated that except for the real GDP per capita and CO_2 emissions per capita, all series, including the informal sector size, are stationary at levels, whereas these two variables are integrated of order 1.

We report three sets of empirical results. The first set generally reports panel fixed-effects regressions and panel co-integration results (Table 2), the second set contains instrumental variable (IV) regression results (Table 3), and the third set consists of regressions with additional control variables (Table 4).

As a first step in the empirical analyses, we used panel fixed-effects models and panel co-integration. The former is used when the relevant sustainable development–related dependent variable is stationary; the latter is used only when we use CO_2 emissions per capita and real GDP per capita as the relevant dependent variables.

For the majority of panel fixed-effects models, we use the fixed-effects estimator with an AR(1) disturbance term, following Baltagi and Wu (1999). However, for several variables, including the adult literacy rate and all social variables except female labor force participation, using the AR(1) disturbance reduces the number of observations to a level where it is not possible to run a fixed-effects estimation. In these cases, we simply use the standard fixed-effects estimator. Finally, when we use mortality due to air pollution as the dependent variable, the limited number of observations allows for only a heteroskedasticity-corrected OLS estimation.

In the case of the fixed-effects estimation, we simply regress the sustainable development indicator on informal sector size as follows:

$$SD_{it} = \alpha_1 + \alpha_2 IS_{it} + \pi_i + \mu_t + \epsilon_{it}$$

Here, for country *i* and year *t*, *SD* denotes the sustainable development indicator used as the dependent variable, and *IS* denotes the informal sector size as a percentage of GDP. The coefficient estimate α_2 measures the magnitude and direction of the association between informal economy size and the relevant sustainable development indicator. In all regressions[13], country fixed effects (π_i), and year fixed effects (μ_t) are also controlled for.

In the second specification, in addition to informal sector size, we also use GDP per capita and its interaction with informal sector size among the independent variables. Estimation results for this first set are presented in Table 2.

For two special cases, when nonstationary CO_2 emissions per capita and real GDP per capita are used as the dependent variables, we run a panel dynamic OLS estimation, following Pedroni (1999, 2001). Again, we report two sets of regressions here, one with only the informal

[13] Our choice of the estimator for a specific regression is always guided by the Hausman specification test. Moreover, we also conduct various other estimations where we allow for cross-sectional dependence and use for regional dummies instead for country fixed effects. Due to space constraints, these additional results are not reported in the paper and are available upon request from the corresponding author.

sector size added to the regression and a second one that adds the informal sector size's interaction with real GDP per capita.

Moreover, in addition to these benchmark estimations, we also run two sets of instrumental variable (IV) regressions (one with informal sector size alone and another one involving its interaction with GDP per capita) for each sustainable development indicator. Here, we use lagged (one, two or three years lagged depending on the results of the J-test) independent variables as instruments for their levels. Except for the two nonstationary sustainable development indices, we use the standard instrumental variable estimation, whereas for these two variables we use the Arellano-Bover/Blundell-Bond linear dynamic panel data estimation. The main rationale behind the use of the lagged independent variables as instruments for levels is that those lagged variables do not have a direct effect on the sustainable development indicators which are one or few years ahead of them, even though they are highly correlated with the future informal sector size, as the informal sector is a highly persistent variable (Elgin, 2020). IV estimations also improve the validity of the preceding results in that they address endogeneity issues that may arise from several factors including the endogeneity of informal sector size as well as measurement issues.

For robustness checks, we also run simple panel fixed-effects estimations with AR(1) errors where we include additional control variables. In this case, the regression equation becomes

$$SD_{it} = \alpha_1 + \alpha_2 IS_{it} + \theta X_{it} + \pi_i + \mu_t + \epsilon_{it}.$$

In this specification, X denotes the additional control variables used in the analysis and θ represents the associated coefficients of these variables.

Finally, we also run some fully joint systems estimations with sustainable development indicators and informality. To do this, using the three-stage least squares estimator, we estimate the following simultaneous system of two equations:

$$SD_{it} = \alpha_1 + \alpha_2 IS_{it} + \epsilon_{it}$$

$$IS_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 G_{it} + \pi_i + \mu_t + \epsilon_{it}$$

In this specification, T_{it} and G represent the overall tax burden and government spending (both as a percentage of GDP) in country *i* and year *t*. One advantage of this model is that it allows us to prescribe some recommendations for policymakers, as we do in the next section.

4. Results and Discussion

Table 2 reports the benchmark estimates for all five categories of sustainable development variables, with and without the interaction with GDP per capita described in the previous section. In the health-related variables group, there was a significantly positive relationship between informal sector size and infant mortality rate, neonatal mortality rate, maternal mortality, and mortality under age five. In contrast, life expectancy and access to safe drinking water were negatively associated with informality. These results are in accordance with our expectations in that a larger informal sector would be associated with adverse health conditions. The negative relationship between informal work and health conditions is consistent with previous empirical research (Da Silva et al., 2005; Aragon et al., 2011; Lopez-Ruiz, 2015; Ruiz et al., 2017).

The estimations also confirm the results with the interaction term. These results show how the relationship between the informal sector and the variables in question changes depending on a country's level of economic development. In the case of the mortality variables, the negative and significant coefficient of the interaction terms suggests that the positive (i.e., adverse) correlation of informal sector size with mortality rates is less pronounced in more affluent countries. This can be considered a beneficial effect of economic development, counteracting the negative impact of the informal sector on these particular health indicators. Similarly, the significantly positive coefficient of the interaction terms of GDP per-capita with the variables of life expectancy and

access to safe drinking water indicates that the negative relationship between these variables and informal sector size becomes less significant as GDP per capita increases. Moreover, two variables—access to basic sanitation and to basic drinking water—that did not initially have significant coefficients became significant when the interaction term was added to the regression. In both cases, the estimated coefficient of informal sector size was significantly negative.

As for the threshold levels of GDP per-capita that affects the signs of the relationship between informality and sustainable development indicators, one should consider the range (the mean, the minimum and the maximum values) of our GDP per-capita variable (see Table 1). In almost all regressions (except for infant and maternal mortality), the sign of the correlation between informality and sustainable development indicators is significantly affected by the level of GDP per-capita.

Regarding economic variables, informal sector size was significantly associated with real GDP per capita, as well as with several poverty measures such as poverty head count and poverty gap. In line with our expectations, a larger informal sector was associated with lower GDP per capita and higher poverty levels. This finding supports a significant body of macro and micro literature on the nexus of economic growth and informality (Loayza, 1997; Johnson et al., 1997; de Soto, 1989; Natarajan 2011). Regarding poverty, our findings are against the argument that workers choose the informal sector to maximize their income and flexibility (Jäckle & Li, 2006; Levenson & Maloney, 1998; Maloney, 2004; Perry et al., 2007). The highly significant negative signs of the interaction terms were not surprising, as they suggest that the adverse impact of the informal sector on poverty rates diminishes with economic development.

In the environmental category, increased size of the informal sector was associated with lower levels of CO_2 emissions per capita (or per GDP). On the other hand, a larger informal sector

was also associated with more air pollution as well as with higher mortality rates resulting from poor air quality. CO_2 emissions are generally associated with capital-intensive production technologies, so the lower CO_2 emission levels are understandable in view of the relatively labor-intensive nature of the informal sector (Elgin & Oztunali, 2014). However, more severe air pollution and higher mortality due to air quality might be explained by other factors common in developing nations, such as imperfect enforcement of environmental rules and regulations, which could be associated with informal sector size.

With regard to education variables, Table 2 provides a clear picture, as a larger informal sector is associated with lower educational attainment and with the percentage of children not receiving primary school education. The model with the interaction term included confirmed these results, suggesting that this unfavorable association becomes less pronounced as GDP per capita increases. Our findings provide significant evidence on the inverse relationship between informality and education level as stated in Bonnet et al. (2019) and indirectly support the findings of Montes et al. (2016) and Kolm and Larsen (2016) in that manner.

Finally, in terms of social variables, the only strongly significant association was with female labor force participation rates (though an association with female adult literacy was significant at the .1 level). The association of a larger informal sector with greater female participation in the labor force is consistent with several prior studies (Chen, 2014; ILO, 2018; Elgin & Elveren, 2019). This finding is in accordance with the fact that the feminization of the labor force—which entails both women's increased participation in paid work and the deterioration of working conditions in previously male jobs (Anker, 1998; Standing, 1999)—and informalization have gone hand in hand in recent decades. We call this phenomenon *feminformalization*.

Because of the possible existence of an endogeneity problem in the benchmark regressions, which could arise due to issues such as omitted variable bias, mismeasurement, or a two-way causality between informal sector size and the sustainable development indicators examined, we also conducted instrumental variable (IV) panel regressions. The associated estimations are reported in Table 3, which shows strikingly similar results to those in Table 2 for all variable categories, thereby confirming the findings of the benchmark analysis.

In yet another robustness check, we employed yet another set of IV estimations with additional control variables among independent variables. The results of these estimations are provided in Table 4 for selected dependent variables from each variable category: life expectancy, poverty head count at $5.50, poverty gap $5.50, CO_2 emissions, secondary schooling, and female labor force participation rate. The results of Table 4 show that the significant correlations between informal sector size and many of the sustainable development indicators persist even after controlling for variables such as GDP per capita, trade openness, economic growth, government spending, and unemployment. This finding indicates the robustness of our empirical results. Moreover, none of the results reported in any of these tables change qualitatively when one uses different estimates of informality, as discussed in the previous section.

Next, Table 5 presents results of the system estimations. Here, we ran a total of six system regressions, using the same selected dependent variables as in Table 4. In each case, the first regression regresses the relevant sustainable development indicator on informal sector size and GDP per capita, whereas the second equation is based on the regression of informal sector size on two policy variables, i.e., tax burden and government spending, both as a percentage of GDP. In each regression, we report the estimated coefficients of both variables, unless one of these has been automatically dropped from the regression due to a low number of observations. Here, we observe

from the second equation in each system estimation that a lower tax burden and a higher level of government spending are both associated with smaller informal sector size, although the latter is significantly only at the .1 level. Moreover, in the first regression, the informal sector's estimated coefficient still has the same size as previously. These results are intuitive and consistent with the literature on the determinants of informality. Since tax evasion is one (but not the only one) of the motives for households and firms to enter the informal economy, one would expect higher taxes to be associated with a relatively larger informal sector (Friedman et al. 2000, Elgin, 2015). On the other hand, government spending usually creates incentives to go formal. Overall, these results suggest[14] that reducing the tax burden and increasing government spending could reduce the size of a country's informal sector and could have a positive effect on several sustainable development indicators.

Table 6 and Table 7 present results of two other robustness checks. Similar to Table 5, in Table 6, we provide results of systems estimations with a different informality measure obtained using the MIMIC method by Medina and Schneider (2019). Overall, the results presented in Table 6 are highly similar to the ones reported in the previous table. We believe that this shows the robustness of our benchmark results. Next, in Table 7 we repeat the benchmark IV regressions reported in the upper panel of Table 4 using two subsets of the data, one using data prior to 1980 (with 1980 included) and yet another one using data only from after 1980. Overall, Table 7 shows no remarkable change between the pre-1980 and post-1980 periods in terms of the effect of informal sector on the selected dependent variables, except for the secondary schooling rate. This

[14] These regressions could potentially be enriched with additional determinants of informality, such as indices of corruption, bureaucratic quality, and tax or legal enforcement. However, these indices are generally available for a much smaller portion of our dataset, and including them in regressions would significantly reduce the total number of observations. For this reason, we do not report regressions including these additional factors; however, they are available upon request from the corresponding author.

is not an unexpected result because even if the growth regimes changes in various countries after 1980, this did not affect the nature of the relationship between informality and the development indicators but just the magnitude of it. We acknowledge that the distinction between these two periods is crucial and deserves further analysis. However, such an attempt is beyond the scope of this paper.

We believe that these results might serve as some policy recommendations for policy makers that are concerned with the relationship between informality and sustainable development indicators.

5. Conclusion

The informal sector plays a vital role in the economic life of developing countries, especially in their poorest regions. Although some earlier studies treated informality as an economic opportunity for the poor (Hart, 1973; ILO, 1972; Sethuraman, 1976; Tokman, 1987), recent studies have highlighted the adverse outcomes of informality with regard to economic growth, poverty, income and gender inequality, and health and environmental problems (World Bank, 2019). Based on these insights, in this study we analyzed the empirical relationship between the informal economy and indicators of sustainable development in a macro context. Our empirical results show that the size of the informal sector is strongly associated with several socio-economic variables. The findings suggest that increasing the size of the informal sector is correlated with lower GDP per capita, CO_2 emissions per capita, rates of school attendance, educational attainment, life expectancy, and access to safe drinking water. Also, a larger informal sector is associated with higher female labor force participation, poverty rates, and mortality rates, as well as greater levels of air pollution. Robustness checks in the forms of additional regressions with the interaction of GDP per capita as well as with additional variables confirmed these results. That is,

our findings reinforce the fact that the informality is a core aspect of sustainable development. Informality means the absence of regulations in working conditions and production process, exacerbating all the key outcomes of health, environment, education, and gender relations. Such deterioration in the existing socio-economic problems in turn reinforces the informality, creating a vicious cycle. Therefore, our findings suggest that eradicating the informality should be the primary goal of any policy design.

Although a growing number of studies have sought to understand the impact of the informal economy on sustainability, most of them focused on a single country or a particular occupation group. These prior studies have not provided a comprehensive picture of the nexus of informality and sustainability. Our much broader approach, encompassing 160 economies over a period of 67 years, confirms that economic informality is negatively associated with several important indicators of sustainable development. Thus, policymakers should pay greater attention to the informal sector and consider its impact when designing economic and social policies to achieve sustainable development goals.

Although we have demonstrated a robust empirical connection between sustainability and informality, further issues should be explored that are beyond the scope of this study. First, our macro approach yielded significant empirical results with an extensive array of variables, yet these findings may not be very helpful in explaining the particular mechanisms by which informality contributes to adverse outcomes in individual countries. Second, and related to the first caveat, our work did not consider the role of unique institutional structures in impacting the relationship between economic informality and sustainable development. Therefore, future research should examine this nexus more closely through single-country case studies.

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Appendix

List of 156 countries:

Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Canada, Central African Republic, Chad, Chile, China, Hong Kong, Macao, Colombia, Comoros, Congo, Costa Rica, Côte d'Ivoire, Croatia, Cyprus, Czech Republic, D.R. of the Congo, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia, Ethiopia, Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Guinea-Bissau, Honduras, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Kyrgyzstan, Lao People's DR, Latvia, Lebanon, Lesotho, Liberia, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Republic of Korea, Republic of Moldova, Romania, Russian Federation, Rwanda, Saint Lucia, Saudi Arabia, Senegal, Sierra Leone, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sudan (Former), Suriname, Sweden, Switzerland, Syrian Arab Republic, Tajikistan, TFYR of

Macedonia, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Tanzania, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Venezuela, Viet Nam, Yemen, Zambia, Zimbabwe.

Table 1: Complete Dataset Summary Statistics

Variable Name (Acronym)	Mean	Std. Dev.	Min.	Max.	Obs.
Informal Sector Size, % GDP (IS)	34.13	14.12	7.84	1.13	7363
Openness, % GDP (Open)	49.40	52.56	1.28	264.15	7724
Growth, %	4.04	6.99	-14.72	21.52	7612
Government Spending, % GDP (Gov. Sp.)	19.30	10.63	3.99	57.28	7724
Unemployment, % (Unemp)	8.19	6.13	0.10	51.50	4734
Tax Burden, % (Tax)	17.16	7.53	0.04	65.42	7895
Health Related Variables					
Life Expectancy, years (LE)	64.78	11.65	18.91	84.28	8888
Infant Mortality Rate, per 1,000 live births (IM)	53.48	47.42	1.70	267.50	7988
Neonatal Mortality Rate, per 1,000 live births (NM)	24.56	19.65	0.90	106.00	7105
Mortality under 5 years, per 1,000 live births (M5)	80.40	80.88	2.20	441.90	7988
Maternal Mortality Ratio, per 100,000 live births (MM)	246.56	358.71	3.0	2900.00	4004
Access to Basic Sanitation, % population (ABS)	71.06	30.79	3.15	100.00	2459
Access to Safe Drinking Water % population (ASD)	764.48	26.46	3.91	10.00	1267
Access to Basic Drinking Water % population (ABD)	83.99	19.13	16.73	100..	2476
Immunization DPT % of children ages 12-23 months (IDPT)	84.08	17.44	6.00	99.00	4096
Immunization HepB3 % of immunized one-year old children (IHB)	83.85	19.67	1.00	99.00	2463
Economic Variables					
Real GDP Per-Capita, PPP in constant 2011 USD (GDP)	16.56	19.54	0.35	135.32	4107
Poverty Headcount: $5.50 (PH550)	36.21	32.82	0.00	100.00	1390
Poverty Headcount: $3.20 (PH320)	22.18	26.72	0.00	98.50	1390
Poverty Headcount: $1.90 (PH190)	11.66	18.54	0.00	94.10	1390
Poverty Gap: $5.50 (PG550)	17.99	20.31	0.00	100.00	1390
Poverty Gap: $3.20 (PG320)	9.61	13.97	0.00	77.10	1390
Poverty Gap: $1.90 (PG190)	4.50	8.35	0.00	63.60	1390
Access to Electricity, % population (AE)	74.38	34.24	0.01	100.00	4150
Environmental Variables					
CO2 Emissions Tons Per Capita (CO2)	4.54	7.98	0.02	100.70	7805
Co2 Emissions per 2010 GDP, kg per 2010 USD GDP (CO2020)	0.51	0.51	0.02	6.10	6809
Co2 Emissions per 2011 PPP GDP (CO2PPP)	0.27	0.21	0.005	1.76	3779
Air Pollution, micrograms per cubic meter (AP)	29.24	17.82	5.89	100.78	1694
Mortality due to Air Pollution, per 100,000 (MAP	87.47	73.85	7.00	324.010	154
Educational Variables					
Tertiary Schooling, % Gross (TS)	23.62	22.80	0.00	126.38	4856
Secondary Schooling, % Gross (SS)	64.38	33.96	0.002	163.93	5212
Adult Literacy, % of literate people ages 15 and above (AL)	79.23	21.84	8.69	99.97	688
Educational Attainment Lower Secondary, % ages above 25 (EDLS)	58.75	28.51	0.60	100.00	959
Educational Attainment Upper Secondary, % ages above 25, (EDUS)	49.56	25.68	0.37	96.31	875
Children not going to School at Primary School Age, % of ages 6-12, (CPS)	14.29	17.60	0.00	89.95	3552
Social Variables					
Teenage Mothers, % of women ages 15-19, (TM)	19.60	10.74	2.10	50.60	319
Suicide Mortality, per 100,000 people, (SM)	10.29	7.51	0.70	52.60	770
Legal Rights Index, 0 to 12 (LR)	4.90	2.70	0.00	12.00	620
Female to Adult Literacy, % (FAL)	0.91	0.12	0.36	1.12	687
Female Labor Force Participation, ILO estimate % (FLFP-ILO))	51.12	16.03	6.08	90.78	4212
Female Labor Force Participation, National Estimate % (FLFP-NAT)	46.31	15.48	1.93	94.40	3348
CPIA Gender Equality Index, 0 to 6 (GEI)	3.46	0.66	1.50	5.00	688

Table 2: Panel Regression and Co-integration Results

	Without Interaction		With Interaction						
	Coeff.	Std. Err.	Coeff.	Std. Err.	Interaction	Std. Err.	Method	Obs.	Countries
Dependent Variable									
Health Related Variables									
Life Expectancy	-1.70**	(0.79)	-1.90*	(0.82)	0.02*	(0.01)	Panel-FE AR(1)	7203	156
Infant Mortality Rate	20.44***	(2.35)	21.25***	(2.46)	-0.08**	(0.04)	Panel-FE AR(1)	6939	154
Neonatal Mortality Rate	7.17***	(0.88)	8.09***	(0.93)	-0.09***	(0.02)	Panel-FE AR(1)	6471	154
Maternal Mortality	145.79***	(34.35)	153.74***	(35.99)	-1.11*	(0.67)	Panel-FE AR(1)	3846	154
Mortality under 5 years	34.58***	(5.39)	36.40***	(5.68)	-0.17*	(0.09)	Panel-FE AR(1)	6939	154
Access to Basic Sanitation	-0.59	(0.82)	-1.39*	(0.84)	0.01	(0.01)	Panel-FE AR(1)	2303	155
Access to Safe Drinking Water	-10.92***	(4.02)	-17.88***	(4.87)	0.17***	(0.06)	Panel-FE AR(1)	1187	80
Access to Basic Drinking Water	-0.80	(0.82)	-1.90**	(0.88)	0.02	(0.01)	Panel-FE AR(1)	2319	156
Immunization DPT	-16.05	(12.02)	-11.35	(12.24)	-0.38	(0.28)	Panel-FE AR(1)	3940	154
Immunization HepB3	24.47	(35.24)	26.23	(41.37)	0.46	(0.51)	Panel-FE AR(1)	2316	145
Economic Variables									
Real GDP Per-Capita (PPP)	-21.897***	(0.16)	NA	NA	NA	NA	Panel-Coint.	6905	156
Poverty Headcount: 5.50	60.08***	(20.66)	89.80***	(23.41)	-6.10***	(0.78)	Panel-FE AR(1)	1248	133
Poverty Headcount: 3.20	49.46***	(17.90)	67.56***	(21.27)	-3.89***	(0.70)	Panel-FE AR(1)	1248	133
Poverty Headcount: 1.90	35.19***	(14.78)	50.89***	(18.40)	-2.21***	(0.54)	Panel-FE AR(1)	1248	133
Poverty Gap: 5.50	37.91***	(13.44)	54.65***	(16.09)	-3.20***	(0.52)	Panel-FE AR(1)	1248	133
Poverty Gap: 3.20	24.83**	(10.79)	37.51***	(13.41)	-1.79***	(0.40)	Panel-FE AR(1)	1248	133
Poverty Gap: 1.90	8.23	(8.80)	14.31	(11.41)	-0.94***	(0.31)	Panel-FE AR(1)	1248	133
Access to Electricity	4.45	(4.92)	2.77	(5.11)	-0.02	(0.10)	Panel-FE AR(1)	3989	156
Environmental Variables									
CO2 Emissions Tons Per Capita	-15.34***	(2.91)	-18.5***	(2.53)	0.86***	(0.14)	Panel Coint.	6149	156
Co2 Emissions per 2010 GDP	-0.24	(0.18)	-0.20	(0.18)	-0.01***	(0.003)	Panel-FE AR(1)	6199	155
Co2 Emissions per 2011 PPP GDP	-0.19*	(0.10)	-0.12	(0.10)	-0.01***	(0.002)	Panel-FE AR(1)	3623	155
Air Pollution (micrograms)	20.28***	(3.53)	18.89***	(4.41)	-0.00	(0.12)	Panel-FE AR(1)	1535	154
Mortality due to Air Pollution†	297.54***	(48.82)	NA	NA	NA	NA	OLS	153	153
Educational Variables									
Tertiary Schooling	-0.50	(6.24)	0.92	(6.22)	0.16*	(0.10)	Panel-FE AR(1)	4389	154
Secondary Schooling	-44.71***	(7.55)	-45.26***	(7.60)	0.33***	(0.11)	Panel-FE AR(1)	4743	154
Adult Literacy	3.46	(14.13)	-1.70	(7.95)	-0.51***	(0.16)	Panel-FE	671	130
Ed. Attainment Lower Secondary	-55.39***	(17.51)	-84.95***	(24.20)	0.19	(0.29)	Panel-FE AR(1)	795	122
Ed. Attainment Upper Secondary	-76.14***	(14.21)	-114.13***	(17.20)	0.58**	(0.26)	Panel-FE AR(1)	732	110
Children w.o. Primary School	51.65***	(8.51)	52.10***	(8.67)	-0.21**	(0.10)	Panel-FE AR(1)	3313	151
Social Variables									
Teenage Mothers	-14.34	(20.20)	-4.56	(19.31)	1.92***	(0.64)	Panel-FE	319	83
Suicide Mortality	-2.16	(5.60)	-3.69	(5.08)	-0.18	(0.13)	Panel-FE	768	154
Legal Rights Index	1.29	(4.35)	-10.69	(10.45)	0.42*	(0.25)	Panel-FE	618	155
Female to Adult Literacy	-0.18*	(0.11)	-0.20	(0.13)	-0.004	(0.003)	Panel-FE	670	130
Female LFPR (ILO)	6.40***	(2.19)	8.00***	(2.30)	-0.07*	(0.04)	Panel-FE AR(1)	4050	156
Female LFPR (National)	19.43**	(8.60)	23.42***	(9.09)	0.12	(0.20)	Panel-FE AR(1)	3115	154
Gender Equality Index	1.22	(1.64)	1.51	(1.53)	0.13	(0.08)	Panel-FE	688	62

All regressions include a constant as well as country and year dummies. Robust standard errors are reported in parentheses. *, **, *** denote 10, 5 and 1% confidence levels, respectively. See Table 1 for a definition of all the variables.

Table 3: IV Panel Regression and Co-integration Results

	Without Interaction			With Interaction						
	Coeff.	Std. Err..	J-Test	Coeff.	Std. Err.	Interaction	Std. Err.	J-Test	Obs.	Countries
Dependent Variable										
Health Related Variables										
Life Expectancy	-6.17*	(1.71)	0.39	-2.00*	(0.65)	0.03*	(0.01)	0.27	6895	155
Infant Mortality Rate	17.21***	(3.41)	0.29	19.99***	(3.11)	-0.07**	(0.04)	0.19	6610	154
Neonatal Mortality Rate	5.23***	(1.29)	0.17	6.20***	1.20)	-0.08***	(0.02)	0.10	6166	154
Maternal Mortality	80.11***	(22.11)	0.13	122.55***	(33.12)	-1.22**	(0.63)	0.14	3532	154
Mortality under 5 years	28.51***	(4.90)	0.20	31.21***	(5.23)	-0.18**	(0.08)	0.18	6606	154
Access to Basic Sanitation	-0.33*	(0.18)	0.16	-0.25	(0.24)	0.02	(0.02)	0.11	2001	154
Access to Safe Drinking Water	-8.11*	(4.40)	0.17	-10.11**	(5.01)	0.15**	(0.07)	0.16	882	79
Access to Basic Drinking Water	-0.65	(0.79)	0.33	-1.70*	(0.89)	0.02	(0.02)	0.09	1991	155
Immunization DPT	-14.23	(11.37)	0.11	-7.89	(9.33)	-0.11	(0.24)	0.17	3620	154
Immunization HepB3	27.11	(22.34)	0.08	23.10	(32.01)	0.39	(0.76)	0.09	2007	145
Economic Variables										
Real GDP Per-Capita (PPP)	-17.839***	(0.79)	0.20	NA	NA	NA	NA	NA	6901	156
Poverty Headcount: 5.50	44.20***	(14.33)	0.18	70.11***	(21.29)	-5.97***	(0.81)	0.21	964	133
Poverty Headcount: 3.20	40.04***	(16.28)	0.19	60.11***	(19.60)	-2.97***	(0.59)	0.22	964	133
Poverty Headcount: 1.90	29.93***	(10.23)	0.31	24.20**	(12.30)	-2.45***	(0.50)	0.29	964	133
Poverty Gap: 5.50	34.18***	(12.75)	0.20	44.11***	(12.34)	-3.01***	(0.40)	0.17	964	133
Poverty Gap: 3.20	19.89*	(10.82)	0.08	23.43**	(11.98)	-1.66***	(0.37)	0.10	964	133
Poverty Gap: 1.90	8.18	(6.44)	0.11	18.44*	(10.44)	-0.36*	(0.20)	0.10	964	133
Access to Electricity	5.20	(5.01)	0.22	3.11	(4.97)	-0.02	(0.03)	0.19	3664	156
Environmental Variables										
CO2 Emissions Tons Per Capita	-12.90***	(3.10)	0.11	-14.50***	(3.53)	0.86***	(0.18)	0.14	5801	156
Co2 Emissions per 2010 GDP	-0.10	(0.22)	0.14	-0.15	(0.23)	-0.02**	(0.01)	0.15	5844	155
Co2 Emissions per 2011 PPP GDP	-0.17*	(0.10)	0.24	-0.12*	(0.07)	-0.02*	(0.01)	0.20	3301	155
Air Pollution (micrograms)	14.74***	(2.65)	(0.12)	12.49***	(3.17)	-0.01	(0.05)	0.20	1220	153
Mortality due to Air Pollution	184.13***	(39.45)	0.14	NA	NA	NA	NA	NA	153	153
Educational Variables										
Tertiary Schooling	-0.24	(2.99)	0.14	0.61	(3.50)	0.17**	(0.08)	0.20	4066	154
Secondary Schooling	-39.89***	(5.87)	0.18	-40.11***	(6.79)	0.29***	(0.08)	0.33	4301	154
Adult Literacy	3.10	(10.99)	0.20	-1.66	(6.01)	-0.44***	(0.13)	0.20	420	128
Ed. Attainment Lower Secondary	-41.71***	(15.33)	0.19	-71.24***	(20.19)	0.15	(0.20)	0.18	550	120
Ed. Attainment Upper Secondary	-70.00***	(17.19)	0.18	-91.29***	(15.66)	0.54**	(0.28)	0.22	510	109
Children not going to Primary School	44.84***	(5.95)	0.29	47.20***	(7.97)	-0.20**	(0.11)	0.15	3010	151
Social Variables										
Teenage Mothers	-11.20	(15.83)	0.18	-3.32	(12.44)	1.00	(0.96)	0.30	180	81
Suicide Mortality	-1.88	(4.21)	0.10	-2.88	(4.11)	-0.10	(0.09)	0.09	460	154
Legal Rights Index	0.98	(3.66)	0.21	0.90	(4.88)	0.220**	(0.10)	0.20	308	155
Female to Adult Literacy	-0.17*	(0.10)	0.17	-0.19*	(0.11)	0.02	(0.02)	0.19	410	130
Female LFPR (ILO)	5.21***	(1.77)	0.15	6.09**	(3.10)	-0.05*	(0.03)	0.11	3738	156
Female LFPR (National)	17.80***	(5.44)	0.23	19.85***	(7.14)	0.10	(0.14)	0.20	2808	154
Gender Equality Index	1.18	(1.44)	0.30	1.10	(1.00)	0.10	(0.08)	0.08	566	62

All regressions include a constant as well as country and year dummies. Robust standard errors are reported in parentheses. *, **, *** denote 1, 5 and 10% confidence levels, respectively. J-Test provides the test for the exogeneity of our instruments. See Table 1 for a definition of all the variables.

Table 4: IV Panel Regressions with Additional Controls

	LE	PH550	PG550	CO2	SS	FLFP-ILO	PH320	PG320	GDP
IS	-2.75***	71.50***	40.47**	-4.82*	-50.51***	10.34***	8.11*	12.11*	-14.12*
	(0.95)	(26.68)	(17.56)	(2.72)	(10.97)	(2.68)	(2.90)	(3.11)	(4.20)
GDP	0.003	-1.38*	-0.71*	0.17*	0.11*	0.003	-0.02**	-0.01*	NA
	(0.004)	(0.24)	(0.06)	(0.01)	(0.04)	(0.01)	(0.01)	(0.00)	NA
Open	-0.002	0.73	0.60	0.28**	-0.22	0.09	0.11*	0.10*	0.03
	(0.03)	(1.71)	(1.13)	(0.14)	(0.74)	(0.12)	(0.06)	(0.06)	(0.02)
Growth	0.09	4.96	-0.09	0.27	-2.76**	-0.33	-0.09	-0.11	0.14*
	(0.08)	(3.95)	(2.61)	(0.26)	(1.25)	(0.23)	(0.15)	(0.15)	(0.08)
Gov. Sp.	-0.13	-0.67	-0.57	-3.07*	-7.09*	0.55	-0.14**	-0.15**	0.09*
	(0.16)	(7.13)	(4.70)	(0.52)	(2.73)	(0.47)	(0.07)	(0.07)	(0.05)
Unemp.	0.004	0.12	0.05	0.009	0.03	-0.002	0.04	0.03	-0.04*
	(0.003)	(0.10)	(0.07)	(0.009)	(0.04)	(0.008)	(0.04)	(0.04)	(0.02)
Observations	4546	1097	1097	4516	3369	3597	1390	1390	4056
Countries	156	133	133	156	154	156	133	133	156
J-test	0.13	0.25	0.27	0.22	0.09	0.06	0.21	0.19	0.21
	IM	NM	MM	M5	ABS	ASD	IDPT	IHB	ABD
IS	14.10***	4.20*	80.11***	-0.87	-8.11**	-10.00	-6.11	-10.40	-1.20
	(2.49)	(2.30)	(20.77)	(0.65)	(4.01)	(11.20)	(22.11)	(10.77)	(0.90)
GDP	-0.04**	-0.09**	-0.10**	0.14*	0.10**	0.04	0.03	0.05	0.07*
	(0.02)	(0.04)	(0.05)	(0.08)	(0.05)	(0.06)	(0.07)	(0.06)	0.04
Open	-0.14	-0.08	-0.28	0.22	0.33	0.14	0.34	0.70	0.43
	(0.38)	(0.11)	(0.14)	(0.18)	(0.23)	(0.29)	(0.30)	(0.66)	(0.39)
Growth	1.12	1.24	0.99	0.68	0.50	0.70	1.00	0.45	0.23
	(0.99)	(1.00)	(1.09)	(0.55)	(0.54)	(0.75)	(0.90)	(0.50)	(0.39)
Gov. Sp.	-0.74**	-0.65*	-0.72**	0.29	0.33	0.44	0.65	0.76	0.44
	(0.37)	(0.35)	(0.37)	(0.44)	(0.51)	(0.52)	(0.55)	(0.62)	(0.39)
Unemp.	0.05*	0.04	0.03	0.01	0.07	0.09	0.10	0.08	-0.04
	(0.03)	(0.04)	(0.04)	(0.04)	(0.06)	(0.09)	(0.11)	(0.12)	(0.06)
Observations	4545	4501	3985	4545	2459	1266	4083	2462	2474
Countries	154	154	154	154	155	88	154	145	156
J-test	0.10	0.08	0.11	0.19	0.17	0.16	0.32	0.38	0.31
	PH190	PG190	CO2010	CO2PPP	AP	MAP	TS	AL	AE
IS	20.14	21.20	0.33	-0.21*	17.11**	144.10***	0.29	4.10	5.20
	(17.11)	(23.10)	(0.27)	(0.11)	(8.60)	(40.11)	(0.30)	(3.91)	(4.12)
GDP	-0.24**	-0.05*	0.18***	0.24***	-0.05	0.03	0.02	0.03	-0.02
	(0.12)	(0.03)	(0.04)	(0.06)	(0.04)	(0.05)	(0.03)	(0.03)	(0.04)
Openness	0.55	0.39	0.34*	0.23	0.17	-0.54	0.56	0.62	0.09
	(1.44)	(1.20)	(0.19)	(0.42)	(0.35)	(0.45)	(0.49)	(0.60)	(0.30)
Growth	-0.09	-0.11	0.05	-0.20	0.09	-0.14	-0.10	-0.22	-0.27
	(0.12)	(0.14)	(0.15)	(0.20)	(0.15)	(0.20)	(0.22)	(0.19)	(0.27)
Gov. Sp.	-0.44*	-0.41*	-0.23	0.09	0.19	0.32	0.29	0.40	0.37
	(0.23)	(0.22)	(0.29)	(0.14)	(0.16)	(0.20)	(0.24)	(0.28)	(0.25)
Unemployment	0.01	0.02	0.03	0.04	0.06	-0.04	0.09	0.10	0.01
	(0.04)	(0.03)	(0.03)	(0.04)	(0.05)	(0.09)	(0.13)	(0.12)	(0.09)
Observations	1248	1248	6190	3620	1534	153	4240	672	3989
Countries	133	133	155	155	154	153	154	130	156
J-test	0.28	0.30	0.23	0.13	0.08	0.09	0.07	0.14	0.20
	EDUS	EDLS	TM	SM	LR	FLFP-NAT	FAL	GEI	CPS
IS	-65.11***	-44.23***	-6.71	2.19	18.10***	-0.23**	2.24	20.11**	44.22**
	(15.20)	(10.11)	(5.20)	(3.21)	(5.00)	(0.12)	(1.99)	(10.09)	(22.34)
GDP	0.07**	0.09**	-0.05	-0.03	0.11*	0.07**	0.04**	0.06	0.05
	(0.03)	(0.04)	(0.06)	(0.09)	(0.06)	(0.03)	(0.01)	(0.04)	(0.05)
Open	0.11	0.15	0.21	-0.04	0.03	0.19	-0.08	0.05	0.08
	(0.24)	(0.25)	(0.22)	(0.09)	(0.18)	(0.20)	(0.10)	(0.15)	(0.09)
Growth	0.04	0.18	-0.05	0.05	0.09	0.03	0.20	0.23	0.32
	(0.29)	(0.32)	(0.22)	(0.24)	(0.30)	(0.27)	(0.29)	(0.33)	(0.41)
Gov. Sp.	0.21*	0.30*	0.22	0.27	0.44	0.56	0.04	0.71	0.66
	(0.12)	(0.16)	(0.34)	(0.45)	(0.59)	(0.52)	(0.50)	(0.56)	(0.59)
Unemp.	-0.12	-0.10	0.04	0.15	0.09	0.07	0.03	0.01	0.20
	(0.18)	(0.14)	(0.20)	(0.19)	(0.18)	(0.10)	(0.13)	(0.09)	(0.15)
Observations	795	735	322	768	620	3120	672	689	3315
Countries	110	122	83	154	155	154	130	62	151
J-test	0.17	0.15	0.25	0.14	0.30	0.35	0.09	0.12	0.23

All regressions are panel IV regressions using lagged variables as instruments in all cases except for MAP, where have a cross-sectional IV estimation with latitude used as an instrument. All panel regressions include a constant as well as country and year dummies. Robust standard errors are reported in parentheses. *, **, *** denote 10, 5 and 1% confidence levels, respectively. See Table 1 for the list of variable acronyms.

Table 5: Systems Estimations

	Dependent Variables					
Independent Variables	LE	IS	PH550	IS	PG550	IS
IS	-69.42***		71.31***		33.42**	
	(3.15)		(22.20)		(15.33)	
GDP	0.13***		-1.64***		-0.92***	
	(0.01)		(0.14)		(0.09)	
Tax		0.32***				
		(0.11)				
Gov. Sp.		-0.19*		-0.21***		-0.17***
		(0.11)		(0.04)		(0.04)
R-squared	0.17	0.13	0.50	0.16	0.38	0.17
Observations	7049	7048	1279	1279	1279	1279
Countries	156	156	133	133	133	133
	Dependent Variables					
Independent Variables	CO2	IS	SS	IS	FLFP-ILO	IS
IS	-3.48**		-254.01***		30.78***	
	(1.60)		(12.69)		(8.51)	
GDP-cap	0.21***		0.29***		0.01	
	(0.02)		(0.04)		(0.03)	
Tax		0.37***		0.03**		0.25**
		(0.13)		(0.01)		(0.12)
Gov. Sp.		-0.25*				-0.20*
		(0.13)				(0.12)
R-squared	0.66	0.14	0.02	0.08	0.04	0.12
Observations	6934	6934	4669	4669	3896	3896
Countries	156	156	154	154	156	156

Standard errors are in parentheses. *, **, *** denote 10, 5, and 1% confidence levels, respectively. In all regressions, a constant is also included but not reported. See Table 1 for the list of variable acronyms.

Table 6: Systems Estimations with a Different Informality Measure

	Dependent Variables					
Independent Variables	LE	IS	PH550	IS	PG550	IS
IS	-64.38***		65.32***		32.40***	
	(4.29)		(20.01)		(12.01)	
GDP-cap	0.11***		-1.50***		-0.87***	
	(0.01)		(0.14)		(0.08)	
Tax		0.33***				
		(0.11)				
Gov. Sp.		-0.20*		-0.17***		-0.18***
		(0.06)		(0.04)		(0.04)
R-squared	0.22	0.16	0.56	0.20	0.42	0.15
Observations	3231	3231	1190	1190	1190	1190
Countries	156	156	133	133	133	133
	Dependent Variables					
Independent Variables	CO2	IS	SS	IS	FLFP-ILO	IS
IS	-3.50***		-240.12***		29.80***	
	(1.20)		(11.97)		(8.44)	
GDP-cap	0.20***		0.21***		0.03	
	(0.03)		(0.04)		(0.03)	
Tax		0.30***		0.02**		0.24**
		(0.12)		(0.01)		(0.12)
Gov. Sp.		-0.26*				-0.24**
		(0.14)				(0.12)
R-squared	0.69	0.15	0.03	0.08	0.09	0.13
Observations	3227	3227	2652	2652	2201	2201
Countries	156	156	154	154	156	156

Standard errors are in parentheses. *, **, *** denote 10, 5, and 1% confidence levels, respectively. In all regressions, a constant is also included but not reported. See Table 1 for the list of variable acronyms.

Table 7: IV Panel Regressions:

	Pre-1980				**Post-1980**			
	LE	CO2	SS	IM	LE	CO2	SS	IM
IS	-2.28***	-3.11**	-54.13***	19.11**	-3.01***	-5.21**	41.10***	11.20**
	(0.61)	(0.40)	(7.20)	(9.65)	(0.99)	(2.68)	(10.29)	(5.50)
GDP	0.02**	0.18*	0.14*	-0.06***	0.01*	-0.09	0.09**	-0.11**
	(0.01)	(0.10)	(0.03)	(0.02)	(0.00)	(0.06)	(0.04)	(0.05)
Open	-0.01	0.34**	-0.20	0.11	-0.05	0.21*	-0.09	0.04
	(0.01)	(0.17)	(0.19)	(0.22)	(0.04)	(0.11)	(0.16)	(0.11)
Growth	0.04	0.36	-1.75	1.00	0.05	0.29	-0.88	1.00
	(0.09)	(0.39)	(1.44)	(0.77)	(0.14)	(0.23)	(0.75)	(0.77)
Gov. Sp.	-0.17	-2.47***	3.90	-0.65**	-0.21	0.74	2.39**	-0.33*
	(0.34)	(0.40)	(2.88)	(0.33)	(0.27)	(0.56)	(0.66)	(0.18)
Unemp.	0.02	0.09	0.01	0.07	0.01	0.02	0.05	-0.02
	(0.03)	(0.10)	(0.01)	(0.07)	(0.03)	(0.05)	(0.03)	(0.04)
Observations	1598	1488	1170	1594	2476	3001	2001	2477
J-test	0.14	0.19	0.25	0.35	0.29	0.16	0.10	0.15

Standard errors are in parentheses. *, **, *** denote 10, 5, and 1% confidence levels, respectively. In all regressions, a constant is also included but not reported. See Table 1 for the list of variable acronyms.