The Informal Economy in Peru: Magnitude and Determinants, 1980–2011

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Abstract

This paper estimates the size of the informal economy in Peru during the period 1980-2011 using the multiple indicators-multiple causes method (MIMIC). Estimates indicate that the informal economy fluctuated between 30% and 45% of official GDP during the period analyzed and exhibited an anti-cyclical behavior, increasing during periods of economic crisis and contracting during economic booms. An econometric exploration of the determinants of the size of the informal economy indicates that productivity plays the leading role, more so than the VAT tax rate. Marginal income tax rates and the minimum wage do not have any effect on the size of the informal economy.

Keywords: informal economy, MIMIC model, minimum wage, productivity, taxes.

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Acronyms

BCR	Central Reserve Bank (Banco Central de la Reserva)
CEPAL	Comisión Económica para América Latina y el Caribe (Economic Commission for Latin America and the Caribbean, ECLAC)
EAP	Economically active population
ENAHO	National Household Survey (Encuesta Nacional de Hogares)
ENVIV	National Living Conditions Survey (Encuesta Nacional de Niveles de Vida)
GST	General Sales Tax
INEI	National Institute for Statistics and Informatics (Instituto Nacional de Estadística e Informática)
LSMS	Living Standards Measurement Survey
MEF	Ministry of Economy and Finances (Ministerio de Economía y Finanzas)
MIMIC	Multiple Indicators-Multiple Causes Method
MSME	Micro, small and medium-sized enterprises
OLS	Ordinary least square

1. INTRODUCTION

There is a broad consensus that Peru has an informal economy of considerable magnitude. Various studies estimate it as between 35% and 60% of GDP in recent years. From the perspective of the size of productive units, this phenomenon is associated with the predominance of small and micro enterprises (MSME) in the Peruvian business sphere.[1] According to official estimates, in 2010 there were approximately 1.2 million formal MSMEs, which represented 99.8% of total formal enterprises in Peru (Ministry of Production and Codepyme 2011).[2] The same source estimated that for each MSME, there are two informal enterprises. As regards formal employment, in 2011 approximately 60% of the occupied economically active population (EAP) was not covered by any pension system.[3] Consequently, any discussion of Peru's informal economy refers to a context of around 2.4 million productive units, which produce between 35% and 60% of the GDP and employ around 60% of the EAP; that is, close to 9.5 million workers. This is the real magnitude of the Peruvian informal economy.

In general, the phenomenon of informality is approached either from the point of view of the labor market or from the added value created. As a result, the informal economy is measured by the percentage of the EAP currently in informal employment. Labor informality has two definitions: a "legal" and a "traditional" one. According to the legal meaning, an informal worker is a person not covered by social security, while according to the traditional meaning, informal workers are those operating or employed in enterprises with up to five workers, non-qualified independent workers and unpaid domestic workers and family members (Chong et al. 2008). Alternatively, the informal economy is measured in terms of its contribution to the GDP, which can be measured by several different methods. In this study, it is measured by its added value as a percentage of the GDP.

It is important to distinguish between the informal economy, the illegal (or criminal) economy, and the underground economy. The informal economy is comprised of legal activities that produce added value, use money in their transactions, and are not registered or do not pay taxes (Schneider and Enste 2000). The illegal economy includes criminal activities such as drug trafficking and smuggling, which also produce added value

1. Micro-enterprises are defined as enterprises with up to ten workers and small enterprises as those with between 11 and 100 workers.
2. Formality is defined here as the enterprise's inscription in the RUC and the SUNAT.
3. According to the figures from ONP and SBS regarding the number of subscribers, and from the INEI on EAP. As a reference, Saavedra (1999) estimated that in 1996, 58.7% of the total EAP were informal workers.

and, obviously, neither pay taxes nor are registered. Finally, the underground economy encompasses both the informal and illegal economies.

An additional issue, little discussed in literature, is how much of the value generated by the informal economy is reflected in the official GDP. If the informal economy is measured in terms of the official GDP, it is crucial to assess whether it is measured adequately or not, which depends on how much of the added value created by the informal (and by the illegal) economy is reflected in the national accounts.

Several studies have been carried out in Peru in an attempt to measure the size of the informal economy as a percentage of GDP, using point estimates for specific periods.[4] The lack of a time series of the informal economy spanning recent decades has limited understanding of its dynamics and determinants, which has made it difficult to design effective policies to promote the formalization of enterprises and independent workers.[5]

The purpose of this study is to estimate the size of the informal economy – in terms of added value generated as a percentage of GDP – in Peru in a time series, from 1980, and to identify its main determinants. The article is organized as follows: the second section, which follows, briefly addresses conceptual aspects relating to the informal economy. The third section reviews the estimates of the size of the informal economy in Peru, discussing their methodological aspects and results. The fourth section describes the methodology employed in this study and the model used to estimate the size of the informal economy in Peru. The fifth section presents the results while the sixth explores the determinants of the size of the informal economy in Peru, based on the time series estimated in the preceding section. Finally, the last section discusses the conclusions and policy implications.

2. CONCEPTUAL ASPECTS

Schneider and Enste (2000) carried out a comprehensive review of the existing literature on the informal economy. Although the title of their study refers to "shadow economies", which would include illegal or criminal activities, the definition that they use is of legal activities that create added value, use cash in their transactions, and either do not pay taxes or are not registered. Thus, in this manner, production for self-consumption, goods

4. See: Loayza (1997); Schneider and Enste (2000); Schneider (2004); Hernández and de la Roca (2003); Vuletin (2008).
5. Escobar (2008) constructs an annual time series for the period 1982-2005. However, he estimates the size of the underground economy, which encompasses both the informal and illegal economy.

and services traded through barter, and criminal activities are all excluded. Consequently, their study concentrates on what is normally defined as the informal economy. In general, this is the definition that is used by the various studies referred to below.

These authors indicate that there are three principal reasons for the large size of the informal economy. First, its growth can represent the reactions of economic agents that are overwhelmed by the state bureaucracy and choose the escape option instead of the voice option; that is, the use of legal measures to attempt to reduce the excessive tax and regulatory burdens. This behavior erodes the tax base and contributions to social security. Second, the increase in the size of the informal economy makes it difficult to design public policies, as it leads to official indicators that are not reliable. It is probable that policies based on erroneous figures for key variables - such as unemployment, underemployment, salaries, and consumption - are ineffective, and even counterproductive.[6] Third, a growing informal economy can attract workers and capital from the official economy and create competition for formal enterprises, with a consequent negative impact on economic growth. However, if a large proportion of the income generated from the informal economy is spent in the formal economy, this benefits the general level of economic activity.

The World Bank (Perry et al. 2007) produced a report on informality in Latin America and the Caribbean, which combines two approaches that are used in the literature: exclusion and escape. The former occurs in three ways, on the border between formality and informality. In first place, the segmentation of the labor market prevents workers from abandoning their state of inertia in the informal economy and finding employment in the formal sector. In second place, the complexity of laws is an obstacle to the formalization of MSMEs (De Soto 1986). Finally, some large enterprises that face excessive tax and/or regulatory burdens can operate in partial informality to evade these burdens.

The perspective of escape, associated with Hirschman (1970), considers that many workers, enterprises and families implicitly carry out a cost-benefit analysis regarding whether or not they should pass into the formal sector. In this manner, high levels of informality are considered a consequence of the fact that a high percentage of enterprises and individuals voluntarily opt out of entering the formal sector, which implies that they question the quality of services provided by the state and its capacity to enforce laws. From this perspective, MSMEs and own-account workers decide on their own to opt for informality because they think that there are few benefits and high costs associated with formality. At the same

6. For example, erroneous figures on the average wage can lead to ill-considered decisions regarding the minimum wage (minimum vital wage), one of whose criteria for readjustment is that it should not approach the average wage too much.

time, unskilled workers who receive low salaries in the formal sector, may decide that this does not compensate for the greater flexibility and consumption available in the informal sector, given that their incomes are tax-free. Finally, large enterprises or skilled workers can decide not to declare all their income because of the benefits of tax evasion in a context where there is little risk because of weak enforcement.

This study assumes that the agents operating in the informal economy in order to escape do so by choice, while those that operate there because of exclusion find themselves in this situation because of structural reasons that are beyond their control. While the former can enter the formal sector when they decide to do so, the latter do not have this option.

The World Bank report (Perry *et al.* 2007) considers that both approaches – exclusion and escape – are complementary rather than mutually exclusive for various reasons. First, countries vary in their histories, the strength of their institutions, and their legal frameworks, so mechanisms of exclusion may be more important in some countries than in others. Second, the heterogeneity of the informal sector is such that the relative importance of exclusion and escape can vary significantly among workers and enterprises in the same country. Third, in some cases it is very difficult to differentiate between exclusion and escape: a microenterprise with low productivity that opts – after carrying out its cost-benefit analysis – to stay informal may see itself as explicitly excluded or self-excluded.

In relation to the causes of informality, Schneider and Enste (2000) point out the most important ones: the tax burden and contributions to social security, the regulatory burden, labor costs, and social transfers. These four factors have a positive impact on the size of the informal sector because high taxes, significant social security contributions, cumbersome regulations (labor, environmental, etc.), and high salaries (including the minimum wage), among other factors, lead enterprises, families and/or workers to the informal economy. On the other hand, the existence of generous social transfers would generate negative incentives for the beneficiaries to seek work in the formal economy. In this context, these individuals might prefer to stay in the informal economy to avoid the costs associated with formality, including payment of taxes that finance social transfers.

The World Bank (Perry *et al.* 2007) found a great deal of heterogeneity in these characteristics, motivations, and preferences of informal workers within and between the countries of Latin America and the Caribbean. Overall, the informal sector is made up of two large groups of workers, which are very different from each other. The first – own-account workers, self-employed workers, or owners of microenterprises – opt for informality given

that their options in the formal sector are at best equally scarce. For these workers, while they usually face low incomes and little security, independent work is a better option than those jobs they could obtain in the formal sector because of their low qualifications, their limited access to other assets, and the low aggregate productivity of the economy.[7] In this way, the majority of independent workers are not excluded from the formal sector but rather opt out of escaping formality on the basis of an implicit cost-benefit analysis.

This situation is very different for the second group; that is, salaried informal workers. The majority seek salaried employment, whether it be in the formal sector or as freelancers. For many of them, informality is, for the most part, a consequence of the decisions of employers, especially microenterprises, to operate outside the formal sector. As a result, exclusion – and not escape – is the overriding reason why they end up in the informal sector.

Two additional results merit discussion here. First, the behavior of labor markets is asymmetric throughout the economic cycle in the majority of countries: they tend to behave as segmented markets during periods of deceleration and recession, and more frequently as integrated markets in periods of economic expansion.[8] Second, informal salaried labor is the point of entry into the labor market for young workers, who can gain experience this way in order to later obtain a job in the formal sector or become freelance workers.

The World Bank report (Perry *et al.* 2007) notes that labor informality is basically a phenomenon of MSMEs, indicating that the vast majority of workers who are not registered in a social security system work in enterprises with less than five workers. At the same time, the report finds that the character and dynamics of microenterprises in Latin America are consistent with similar enterprises in developed countries. Thus, for example, the patterns of entry, escape, and participation in independent employment (own-account workers and owners of microenterprises) by ages are very similar in the United States and Mexico. In this way, the phenomenon of informality in Latin America has characteristics and dynamics consistent with those in developed countries, only that the sector is much larger. It is suggested that this could be due to lower labor productivity in the formal sector in developing countries, which diminishes the

7. It is considered that the greater the aggregate productivity of the economy, the more attractive formality will be in relation to informality.
8. Of the five countries studied in greatest depth in the World Bank report (Perry et al. 2007), the labor markets of Mexico and the Dominican Republic had the highest levels of integration while those of Argentina, Colombia, and Brazil showed signs of segmentation.

opportunity cost of independent employment. Certainly, formality can be seen as an input in the production process of the MSME that they do not consider necessary. In addition, it has been observed that formality increases rapidly with the size of the enterprise and with its productivity.

Nevertheless, the description of the great majority of microenterprises in Latin America indicates that they continue to be too small to obtain benefits of formality that exceed their costs. Therefore, the report notes that the majority of these enterprises do not have growth potential and, thus, their needs for credit are limited.[9] At the same time, their customer base is limited and they have personal relationships with most of them. Therefore, they do not benefit substantially from greater access to the market and the other services associated with formality. In this scenario, it is not surprising that in most cases as the level of formality increases, so too does the size of the enterprise, its demand for formal services, and the probability that it will be detected by government inspectors.

The fact that most of the workforce in the countries of the region is employed in informal microenterprises could entail losses in productivity for various reasons.[10] The first is related to economies of scale or externalities that are generated in larger enterprises. The second reason is that disloyal competition by informal enterprises can discourage innovation and the adoption of new technologies by formal enterprises. Finally, formality implies greater access to markets and services and therefore to greater aggregate productivity.

The previously cited World Bank report (Perry *et al.* 2007) indicates that studies of microenterprises demonstrate that those that decide to legally register tend to perform better, while those that started their operations after registering have, on average, higher levels of labor productivity in comparison to similar unregistered enterprises. Additionally, the evidence regarding the investment climate indicates that informal enterprises that are surrounded by formal enterprises have higher levels of productivity.

On the basis of the evidence presented, the report concludes that if one seeks a positive cost-benefit analysis for formalization of a significant portion of informal enterprises, one needs a suitable combination of incentives and penalties. Interventions to reduce costs by eliminating excessive regulation and/or reducing tax rates for MSMEs may not be sufficient

9. In the case of Peru, Villarán (2000) found that 70% of MSMEs were subsistence enterprises during the second half of the 1990s.
10. In reality, the relationship of causality could also be the inverse: the low productivity of enterprises and workers pushes them into informality. Of course, this is the principal result of the econometric exercise, as will be seen in the sixth section of this article.

to substantially increase their levels of formality. This is consistent with findings regarding the effects of Peru's MSME law.[11] Thus, the World Bank (Perry et al. 2007) notes that achieving mass formalization of enterprises also requires the improvement of incentives to formalize, including improvements to public and private services that are at the disposal of formal enterprises (technical assistance, credit, adherence to contracts, etc.), in addition to increasing official oversight. These elements contribute to a rise in the opportunity cost of remaining informal.

Nevertheless, the aggregated low productivity in the formal sector undermines the effectiveness of integral and well-designed programs in promoting formalization of enterprises (which combine increases in benefits with cost reductions and improved oversight). As a result, much of the efforts to achieve formalization should be concentrated on productive development policies that increase productivity and accelerate the growth of the formal sector in such a way as to significantly and visibly increase the benefits of formality.

Finally, in many countries, even some large enterprises partially engage in tax evasion and labor informality. In such cases, these enterprises also carry out a cost-benefit analysis between the "private" benefits of informality (lower tax payments, lower labor costs, etc.) and the costs (risk of fines and sanctions, including the need to pay bribes in some cases). This type of informality can be combated by simplifying compliance with laws, eliminating excessive taxation, and improving accountability.

In respect to specific studies on the formal economy in Peru, Yamada (1996) found evidence in support of the hypothesis that urban informal self-employed workers choose this type of work rather than becoming salaried workers, and that they earn competitive salaries; moreover, only those who have better entrepreneurial capacities remain in this labor sector. On the basis of two surveys of households carried out in Lima (1985-1986 and 1990,[12] he encountered premiums for the projected income for self-employed informal workers versus salaried (formal and informal) workers of between 16% and 43% in

11. The Law for the Promotion of Competition, Formalization and Development of the Micro and Small Enterprise and Access to Decent Employment (Ley de Promoción de la Competitividad, Formalización y Desarrollo de la Micro y Pequeña Empresa y del Acceso al Empleo Decente), was promulgated in June 2008. The law established differentiated treatment on labor and taxes for those MSMEs that registered under this law. However, in 2009 and 2010, the first two years that the law was in force, the MSMEs that formalized themselves by registering in the RUC was almost twice the number that registered in the Special Register of MSMEs (Registro Especial de la MYPE, REMYPE). The unsatisfactory results of the MSME law were acknowledged with its modification in July 2013.
12. Standard of living surveys (World Bank).

1985-1986 and between 22% and 123% in 1990, depending on the technique used to estimate projections of income.[13] At the same time, he finds discounts for the projected income of informal salaried workers versus urban self-employed workers of between 15% and 27% in 1985-1986, and between 27% and 31% in 1990. The estimated discounts in the projected income of informal salaried workers versus formal salaried workers are between 20% and 24% in 1985-1986, and between 11% and 14% in 1990. On the other hand, utilizing panel data techniques to estimate equations for labor income, Yamada (1996) found that workers who migrated from the informal self-employed sector to the salaried sector in 1985-1986 and 1990 earned more than 45.2% less than those who remained in the former sector.

Consequently, Yamada's (1996) results would support the escape hypothesis of formality in the case of informal self-employed workers and for the informality by exclusion hypothesis in the case of salaried informal workers. Nevertheless, Yamada draws attention to the fact that the data utilized were obtained through self-reporting questionnaires on income and expenses in a context of high and unstable rates of inflation. Thus, he concludes that the validity of the results should be evaluated again in a more stable economic context.

On the other hand, Saavedra and Chong (1999) studied the behavior of the informal sector in Peru in the period immediately after the structural reforms implemented at the beginning of the 1990s. They investigate whether the informal sector behaves more like a survival sector or as a dynamic sector, comparing labor incomes in the formal sector with those of the informal sector and investigating whether a segmentation problem exists in the labor market. According to surveys measuring standards of living (*Living Standards Measurement Surveys, LSMS*), informal salaried workers have a lower level of education, training, and work experience than informal self-employed workers. Additionally, the gaps in income between formal and informal salaried workers are greater than those that exist between self-employed formal and informal workers.

In regard to the behavior of the informal sector (measured in terms of the workforce), these authors state that the results depend on the definition used. If the legal definition is used, the informal sector decreased from 56.8% of the labor force in 1990 to 54.8% in 1995, while, if the traditional definition is employed, it increased from 50.4% to 53.3% in the same period. The authors are inclined to prefer the legal definition, given that

13. Minimum ordinary squares (MOS) versus the Heckman-Lee two-stage selection model (see Heckman 1979 and Lee 1978).

the acceptance of the traditional definition would lead to acceptance that there was an increase in informality at a time during the 1990s when reforms were being carried out in Peru.

When, on the basis of these surveys, Saavedra and Chong (1999) calculated the incomes of formal and informal and self-employed and salaried workers, they found that in 1994, the hourly wage of informal workers represented 66% of the wages of formal workers; and that the wages of informal self-employed workers reached 77% of those of their peers in the formal sector. At the same time, they state that in the formal sector, self-employed workers have hourly wages that are 14% higher than their salaried peers. Finally, their calculations indicate that, within the formal sector, the hourly wage of the self-employed is double that of salaried workers, who were the poorest paid of all.

On the basis of an estimate of structural equations for the income of four types of workers (self-employed and salaried, formal and informal), Saavedra and Chong (1999) find that the differentials in income are significantly reduced – even becoming negligible in some cases – for three categories of income when the level of education, experience, training, gender, and civil status are controlled for and the other categories cannot be explained for the control variables considered: they earned 26% less than formal salaried workers, 29% less than self-employed formal workers, and 33% less than informal self-employed workers. However, the authors point out that these results do not constitute conclusive evidence of the segmentation of the labor market. Rather, the authors explain them by arguing that human capital can have different levels of productivity, depending on the activity. Thus, informal salaried workers can receive lower returns on education because the work they carry out is repetitive and does not require particular skills, leaving little room for differentiation in income based on educational differentiation.

The authors conclude that low salaries, young age, and limited work experience, together with the fact that returns on work experience are positive, could suggest that informal workers are not sufficiently productive to enter the formal sector. They think that employment in the informal sector could be seen as a temporary stage until the worker's productivity increases and he/she can find a better job. Saavedra and Chong's (1999) interpretation is therefore consistent with the hypothesis of informality through exclusion and contrasts with that of Yamada (1996) for informal self-employed workers, who are posited to be in this situation by their own choice, which is consistent with the hypothesis of informality by escape.

Chong *et al.* (2008) estimates the probability of a worker being employed in the informal sector and the changes that could have taken place in his/her situation as a result of

the effects of the reforms in the labor market at the beginning of the 1990s. On the basis of the results of the ENAHO (ENAHO; INEI) for metropolitan Lima, they estimate probit models in two periods, 1986-1991 (before the reforms) and 1991-2001 (after the reforms). As control variables, they include some associated with human capital (education, training, experience) and others that could affect tastes and preferences (gender, civil status, age).

Their results indicate that the workers who have a higher level of education and more job training have less prospects of finding a job in the informal sector. Using the legal definition of informality, they estimate that possessing a university education reduced by 20% the probability of being in the informal sector before the reforms. This percentage went up to 28% after the reforms. Similarly, workers who receive job training reduce their probability of working in the informal sector by 14% and 27% before and after the reforms, respectively. The use of the traditional definition of informality does not change the qualitative results.

Additionally, based on the estimates of multinomial logit models, Chong *et al.* (2008) finds that male workers have less probability of working as self-employed informal workers, but more to be employed as informal salaried workers than female workers. The probability of being employed as salaried informal workers for men increased from 4% to 8% between 1986 and 1994. It is also more probable that married workers of both sexes work as self-employed informal workers and it is less probable that they work as informal salaried workers both before and after the reforms.

Finally, Chong *et al.* (2008) carry out an evaluation of the impact of the Projoven job training program. This program was initiated in Lima in 1995 with the objective of increasing the employability and productivity of low income youth between 16 and 24 years of age by training them for specific jobs and in specific skills such as mechanics, electricians, checkout operators, plumbers, textile operators, and in the use of sewing machines and computer skills, among others. This program combined formal training with on-the-job training.

On the basis of samples from five different cohorts of participants in the program and five corresponding control groups, the authors carried out an impact evaluation using local polynomial pairing methods (Heckman et al. 1997). The pairing criteria are gender, age, level of education, labor situation, and the level of poverty, and the polynomial pairs live in the same vicinity as the beneficiaries. The variables of interest in the results are level and quality of employment. The latter is approximated through five variables: size of firm, health insurance, insurance for accidents at work, pension system, and formal contract.

There are four principal results of the Chong et al. study. First, the impact of Projoven on the level of employment is positive but very small: the participants increased their level of employment by 5% as a result of the program, 8% in the case of women and 0% in the case of men. Second, there are important effects on all the variables related to quality of employment both for men and women. This is a key result since it illustrates a negative relation between productivity and informality. Third, the impact of Projoven on the quality of employment is not stable in time; it has higher effects in the short term (after six months of participation in the program) than in the medium term (after 12 months of participation). This creates doubts about the sustainability of these effects over time. Four, given the reduced coverage of the program, the effects of general equilibrium on the labor market are insignificant.

The evidence found by Chong et al. (2008) regarding a negative relationship between productivity and informality (by way of evaluating the impact of the Projoven program) turns out to be very important, as will be seen later, and is consistent with the hypothesis of informality by exclusion.

3. PREVIOUS ESTIMATES ABOUT THE MAGNITUDE OF INFORMALITY IN PERU

There are various methods for measuring the size of the informal economy. Table 1 shows informality as a percentage of GDP in the two-year period 2002-2003, in different countries in the world as estimated by Schneider (2004), using the model of multiple indicators and multiple causes (MIMIC), which is explained in detail in the following section. On the regional level, Africa and Latin America are the regions that have the highest level of participation in the informal economy, with simple averages of over 43% of official GDP. On the other extreme, the developed countries have smaller-sized informal economies, with a simple average of 16.3% of GDP. Asia is in an intermediate position, with an average of 30.8% of GDP. These figures suggest that there is an inverse relationship between the level of development and the size of the informal economy. In the case of Africa, South Africa – the most developed country in the region – has a smaller informal sector, 30% of GDP. Something similar occurs in Latin America and the Caribbean, where Chile, perhaps the most institutionalized country in the region, has the smallest informal economy (20.9% of GDP), while at the other extreme, Bolivia, one of the poorest countries in the region, has the largest informal economy (68.3% of GDP). According to this measurement, Peru has an informal economy greater than 60% of official GDP and only Bolivia and Panama have larger informal sectors among the 21 countries in the region included in this study.

Table 1
Size of informal sector, by groups of countries and by country, 2002-2003 (percentage of GDP)

Countries[1]	Oficial GDP(%)
Africa (37)	43.2[3]
- South Africa (Min)[2]	29.5
- Zimbabwe (Max)	63,2
Asia (27)	30.8[3]
- South Korea	28.8
- Hong Kong	17.2
- Malaysia	32.3
- Singapore (Min)	13.7
- Thailand (Max)	54.1
- India	25.6
Latin America and the Caribbean (21)	43.4[3]
- Argentina	28.9
- Bolivia (Max)	68.3
- Brazil	42.3
- Chile (Min)	20.9
- Colombia	43.4
- Mexico	33.2
- Peru	60.9[3]
Countries in Transition (25)	40.1[3]
Developed countries (21)	16.3[3]
- United States (Min)	8.4
- Japan	10.8
- Germany	16.8
- Spain	22.0
- greese (Max)	28.2

Notes:
(1) The numbers in parenthesis refer to the number of countries considered in a region or within a group of countries.
(2) The expressions Max and Min refer to maximum or minimum value, respectively, in the region or corresponding group of countries.
(3) Simple average.
Source: Schneider (2004).

As indicated in the introduction, the various studies that have estimated the size of the informal economy in Peru have taken into account one year or a particular period; that is, they have carried out a single observation of this quantification with the exception of Schneider's (2004) study, which carried out three observations for two-year periods between 1999 and 2003. In the majority of cases, these estimates were carried out using cross-section

studies which included various countries. For example, Loayza (1997), Schneider (2004), and Vuletin (2008) estimated the size of the informal economy in Peru as a percentage of official GDP as part of a calculation for 14 countries in Latin America in 1990-1993; 145 countries around the world in 1999-2000, 2001-2002 and 2002-2003; and 32 countries in Latin America and the Caribbean in 2000-2003, respectively. In these three cases, the method used was MIMIC, which is also the method used in this study to construct the time series for the size of the informal sector in Peru.

On the other hand, Schneider and Enste (2000) and Hernández and De la Roca (2003) estimated the size of the informal economy in Peru using the methods of electricity consumption and the discrepancy in consumption expenses, respectively. The method of electricity consumption was introduced by Kaufmann and Kaliberda (1996) and refined by Lackó (1997). It takes the rate of increase of electricity consumption as an indicator of the rate of total (formal and informal) GDP growth. Consequently, any discrepancy between the rate of real official GDP growth and the rate of electricity consumption is attributed to the performance of the informal economy. This method requires an estimate of the informal economy for a particular year; thus, it is only useful in determining the rate of growth of the informal economy and not its size. Alternatively, the base year chosen can be one during which it is assumed that an informal economy did not exist, which, of course, is problematic. In the case of Hernández and De la Roca (2003), the authors base their estimate for 2000 on the discrepancy between the expenditures for consumption in the official national accounts and those derived from the household survey. The discrepancy between the two calculations is attributed to the informal economy.

The electricity consumption method has been criticized for various reasons. It starts with estimates of elasticity of electricity consumption-GDP close to 1. From there on, any discrepancy between the growth of electricity consumption and official GDP is attributed to the informal economy. The first problem is that not all informal activities require a large consumption of electricity; one such example is professional services. In addition, other sources of energy can be used, such as coal, kerosene, and wood in the case of activities related to the preparation and sale of food. Consequently, the growth of an important segment of the informal economy is not captured by this method. A second problem is associated with the fact that the elasticity electricity consumption-GDP can vary between countries and across time. If this is not close to 1, the method needs to be readjusted according to the value of the elasticity. Finally, this method considers any increase in electrification – for example, to rural zones – as an expansion of informal GDP.[14]

14. This was brought to my attention by an anonymous reader.

In relation to the method of discrepancy in expenditures for consumption, the principal criticism has to do with the accuracy of the calculations of national accounts and with the design and representativeness of the household survey used. The fact is that the difference between the consumption expenditures recorded in national accounts and those derived from the household survey reflect not only the size of the informal economy but also all the errors and omissions in national accounting as well as those in the design and implementation of the survey. Additionally, it is known that the higher income deciles tend to be under-represented in household surveys.

Table 2 provides the various calculations of the magnitude of the informal sector in Peru. As can be seen, they yielded quite different results. Thus, the distance between the estimate of Schneider and Enste (2000) for 1989-1990 and that of de Loayza (1997) for 1990-1993 is very significant: around 14 percentage points of GDP. In addition, Schneider (2004) estimates the informal economy to be significantly larger than do Hernández and De la Roca (2003) and Vuletin (2008). The former study calculates it as around 60% of GDP at the beginning of the 2000s, while the other studies calculate the informal economy as less than 40% of GDP over these same years. This enormous difference could be explained, at least partially, by the fact that the MIMIC method produces estimates relative to the magnitude of the informal economy (ranking) and not absolute estimates. In order to obtain the size of the informal economy as a percentage of GDP, a point calculation obtained in the same independent or parallel manner is needed. On this basis, the estimated ranking enables the calculation of absolute sizes (aggregate value as a percentage of GDP) for all the countries (in the case of a cross-section) or all the years (in the case of a time series).

Table 2
Size of informal sector according to various sources, Peru, 1989–2003 (percentage of GDP)

Source	Period	Method	GDP (%)
Schneider and Enste (2000)	1989-1990	Electricity	44.0
Loayza (1997)	1990-1993	MIMIC	57.9
Schneider (2004)	1999-2000	MIMIC	59.9
Schneider (2004)	2001-2002	MIMIC	60.3
Schneider (2004)	2002-2003	MIMIC	60.9
Hernández and De la Roca (2003)	2000	Discrepancy in consumption expenditure	37.0
Vuletin (2008)	2000-2003	MIMIC	38.1

It is worth emphasizing the closeness of the estimates of Hernández and De la Roca (2003) and of Vuletin (2008) for 2000, despite the different methods used. As will be seen below, in this study the values that are used in these studies will be used to transform the estimates relative to the size of the informal economy in Peru in the period 1980-2011 using the MIMIC method in absolute values (aggregate value as a percentage of GDP).

The vast distances between the values calculated, as shown in Table 2, merit discussion. The gap between Schneider and Enste's (2000) estimates and those of de Loayza (1997) for the beginning of the 1990s could be explained by the different methods used.[15] But, how are we to understand the differences between Schneider's (2004) estimate of 60% of GDP for 1999-2003 and Vuletin's (2008) estimate of 38.1% of GDP for 2000-2003 using the same method? Of course, a difference in GDP of 22 percentage points raises well-founded suspicions on the reliability of the results obtained using the MIMIC method. On this point, what is crucial is the point value used to transform the relative values calculated into absolute values (aggregate value as a percentage of GDP). Evidently, if these point values differ greatly, all the estimated values would also differ significantly. Schneider (2004) calculates the size of the informal economy in 145 countries, using point values for different countries taken from different studies, although he does not mention these values. In the case of Vuletin (2008), he takes this seed value from De la Roca et al. (2002), who estimate that the aggregate value generated by the informal economy in Jamaica represents 35% of GDP for the two-year period 2000-2001. This appears to be the principal source of the discrepancies between the orders of magnitude estimated by these studies.

Beyond methodological explanations, it is worth reflecting on the likelihood of the different results. Considering that informal employment in Peru at the beginning of the past decade was in the range of 60% to 70% of the EAP,[16] is it credible that these workers would have produced 60% of the GDP, as Schneider (2004) estimates? If the majority of informal workers work in microenterprises or are freelance workers, this figure does not make sense. Chacaltana (2008) calculates labor productivity by size of enterprise in Peru in 2006. According to his calculations, the productivity differences are enormous, and highly unfavorable for workers in microenterprises (including independent workers):

15. For the implementation of the MIMIC method, Loayza (1997) uses as the point value the informal sector in Chile (as percentage of GDP), which he supposes is equal to the evasion rate of the aggregated value tax (VAT), estimated at 18.2%.
16. According CEPAL (2012) statistics on the basis of ENAHO in 2001, 71.6% of employed workers were in "low productivity" jobs and defined themselves as freelance workers without professional or technical qualifications, microenterprises of up to 5 workers, and domestic workers. This definition of low productivity jobs coincides with the traditional definition of informal work, as noted in the introduction.

from 15 to 1 versus the productivity of workers in large enterprises, 8 to 1 versus workers in medium-sized enterprises and 2.5 to 1 versus small enterprises. If these calculations are correct, it is not possible that 60 to 70% of informal workers generate 60% of GDP. Consequently, Vuletin's estimate (2008) seems more reasonable. This would appear to be confirmed by Hernández and De la Roca (2003), who obtain similar figures using another method.

4. METHODOLOGY AND ESTIMATED MODEL

The MIMIC method estimates the magnitude of the informal economy as a latent (not observable) variable on the basis of structural equations that link its causes and its indicators, expressed as observable variables. The structural formulation is presented in equations (1) and (2):

(1) $EI_t = \beta' X_t + \varepsilon_t$

(2) $Y_t = \gamma EI_t + \mu_t$

where:

EI = size of the informal economy (unobservable latent scale variable);
X = vector of causes of the informal economy q x 1;
Y = vector of indicators of the informal economy p x 1;
β = vector of parameters q x 1;
γ = vector of parameters p x 1;
ε is a random scale perturbation;
μ is vector pf random perturbations p x 1; y
t indicates the year.

Assuming that the perturbations are distributed normally and in an uncorrelated manner with $var(\mu) = \sigma^2_\mu$ and $cov(\varepsilon) = \theta_\varepsilon$, equations (1) and (2) link the informal economy with a combination of observable exogenous causes (*X*) and with a set of observable endogenous indicators (*Y*). Replacing (1) in (2) produces the reduced form of the model:

(3) $Y_t = \delta X_t + \omega_t$

where:

$\delta = \gamma \beta'$ is a matrix p x q of parameters; and
$\omega = \gamma\varepsilon + \mu$ is a vector of perturbations p x 1 with $cov(\omega) = \gamma\gamma' \sigma^2_\mu + \theta_\varepsilon$.

Given that variables *X* and Y are observable, the reduced-form equation (3) can be estimated by maximum likelihood using the restrictions implicit in the matrix of coefficients δ and in the matrix of variances and covariances of perturbation aω. However, identifying the structural parameters necessary to estimate the size of the informal economy – coefficients β - requires a normalization of the estimated parameters of equation (2). Typically, this is done by imposing the value of 1 on to the first element of the vector of parameters γ, if a positive relationship is assumed between the respective indicator and the size of the informal economy.[17]

As the structural coefficients β and γ are estimated by imposing an arbitrary value for an element of γ, the estimated parameters $\hat{\beta}$ and $\hat{\gamma}$ are standardized as follows:

(4) $\hat{\beta}^s = \hat{\beta}\left(\frac{\hat{\sigma}x}{\hat{\sigma}\,EI}\right)$

(5) $\hat{\gamma}^s = \hat{\gamma}\left(\frac{\hat{\sigma}\,EI}{\hat{\sigma}\,Y}\right)$

As a consequence, the estimated standardized parameters $\hat{\beta}^s$ and $\hat{\gamma}^s$ express the increase in the terms of standard deviations of the dependent variable (*EI* and *Y*, respectively), with an increase in the standard deviation of the explanatory variable (*X* and *EI*, respectively), maintaining the other variables constant.

Using the $\hat{\beta}^s$ and the observed values of X_t and letting $\varepsilon_t = 0$, based on equation (1), one can obtain the ordinal values of the size of the informal economy. Below, using the value of the informal economy as a percentage of GDP for a specific year, these ordinal values can be converted into absolute values for the complete time series.

Loayza (1997) applies the MIMIC method to estimate the size of the informal economy in 14 countries in Latin America and the Caribbean in one year of the four-year period 1990-1993, while Vuletin (2008) does the same for 32 countries in one year during the four-year period 2000-2003. Table 3 presents the variables used in both studies. As causes of the informal economy, both authors include the tax burden,[18] some measure of the rigidity of the labor market, and institutional strength. Only the latter would have a negative impact on the size of the informal economy, while the other two would have

17. Alternatively, if the relationship between the first variable of the vector of indicators and the size of the informal sector is presumed to be negative, this arbitrary value can be set as -1.
18. Loayza (1997) uses the marginal tax rate on corporate income while Vuletin (2008) uses the average of the marginal rates of personal income taxes and corporate taxes.

a positive effect. Moreover, Vuletin (2008) includes a measure of the importance of the agricultural sector in the economy as a cause of the informal economy. The idea is that the greater the agricultural sector, the greater the informal economy, given that informal work is segmented by sectors, with a predominance in the agricultural sector. One of the reasons for this is the lesser presence of the state in rural areas and its lower capacity to enforce the law. Finally, this author also includes the inflation rate as an explanatory factor for the informal economy, since a sustained increase in prices leads to an increase in the nominal income of individuals and enterprises (though they decrease in real terms), which can lead to higher marginal rates of income taxes, resulting in a stimulus for informal activities. Additionally, inflationary processes, because they induce changes in the distribution of income, tend to end up inhibiting the fulfillment of tax obligations, thus creating incentives for informality.

In relation to indicators of the informal economy, both studies take into consideration the workforce's level of social security affiliation. In addition, Vuletin (2008) includes the level of unionization and the gross rate of high school enrollment as a proxy for the net rate of elementary school enrollment, a variable for which the author did not have enough information. The logic for including this last variable as an indicator is that it is assumed that there is child labor in the informal economy, which is prohibited in formal activities. If this is so, then higher levels of the informal economy are reflected in lower rates of primary school enrollment. In contrast, Loayza (1997) includes the rate of evasion of value added tax (VAT; in Peru, called the IGV, General Sales Tax).

Table 4 shows the general (initial) specification of the MIMIC model estimated in this study. As causes, it includes variables that are similar to those used by Loayza (1997) and/or Vuletin (2008), such as: rates of taxation, minimum wage, the importance of the agricultural sector in the economy, and the inflation rate. Similarly, other variables considered by these authors are included as indicators: rate of VAT tax evasion, the size of the labor force covered by social security and the net rate of primary school enrollment. In the econometric modeling exercise, additional variables were considered in the same way as causes. These include the importance of the rural population as an alternative measure of the size of the agriculture sector in the economy. At the same time, real per capita GDP is included as a proxy for labor productivity. In relation to this, the argument is that greater aggregate productivity of the economy disincentivizes informal activity because it elevates the benefits of greater access to the market (including abroad) and the services associated with formality, with which the opportunity cost of own-account employment increases (Perry *et al.* 2007; Loayza and Rigolini 2006).

Table 3
MIMIC Model: causes and indicators of the informal economy, according to Loayza and Vuletin

Aspects considered	Loayza (1997)		Vuletin (2008)	
	Causes	Indicators	Causes	Indicators
Tax evasion	Marginal rate of corporate income tax.	Evasion of VAT as a percentage of GDP.	Average marginal rate of personal income tax and corporate income tax.	
Rigidity of labor market	Rama's (1995) Index as a percentage of per capita GDP (considers eight factors, including number of vacation days, number of days of maternity leave, minimum wage as a percentage of the average salary, and contributions to social security as a percentage of salaries).	Non-agricultural workers not covered by social security as a percentage of total workers.	Minimum wage as a percentage of per capita GDP.	Workers who contribute to social security as a percentage of the EAP.
			Average minimum wage as a percentage of per capita GDP and of the contributions to social security as a percentage of salaries.	Workers belonging to trade unions as a percentage of the EAP.
Institutional strength and compliance with laws	Average of subjective indices of quality of bureaucracy, control of government corruption, and the rule of law, from the *International Country Risk Guide*.		Average of the subjective indices of quality of bureaucracy, control of government corruption, and rule of law from the International Country Risk Guide.	Gross rate of high school enrollment as a proxy for the net rate of elementary school enrollment.
Exports			Exports of agricultural products as a percentage of total exports.	
Inflation			Average inflation rate.	

Sources: Loayza (1997) and Vuletin (2008); compiled by author.

Finally, a gross secondary and tertiary education enrollment rate is included as a proxy for the level of job training of the labor force, since various studies have found that the higher the skills of the workers, the smaller the size of the informal economy (Perry *et al.* 2007; De Paula and Sheinkman 2007; Maloney 2003). The series are annual between 1970 and 2011, with the exception of tax rates, where the series starts in 1980, and the percentage of workers affiliated to social security (pensions), where the series starts in 1984. In this way, various models are estimated, some since 1970, others since 1980 and still others since 1984, depending on the availability of data.

Table 4
MIMIC model for calculating the size of the informal sector in Peru

Causes	Indicators
Marginal rate of personal income tax, marginal rate of corporate income tax, general VAT rate(1)	Evasion of VAT collection as a percentage of potential taxation(5)
Minimum wage as a percentage of per capita GDP(2)	Workers affiliated to the pension system (public and private) as a percentage of the EAP(6)
Transfers by the central government as a percentage of GDP(3)	Net rate of elementary school enrollment(4)
Agricultural sector production as a percentage of GDP(3)	
Rural population as a percentage of the total population(4)	
Inflation rate(3)	
Real GDP per inhabitant(2)	
Gross high school enrollment rate(4)	
Gross tertiary education enrollment rate(4)	

Sources: compiled by the author, based on:
(1) SUNAT.
(2) INEI and BCR.
(3) BCR.
(4) World Bank and INEI.
(5) BCR and SUNAT. Potential taxation is calculated by applying the general VAT rate for consumption expenditures of the public and private sectors from the national accounts at current prices.
(6) INEI, MEF, SBS, and Verdera (1994).

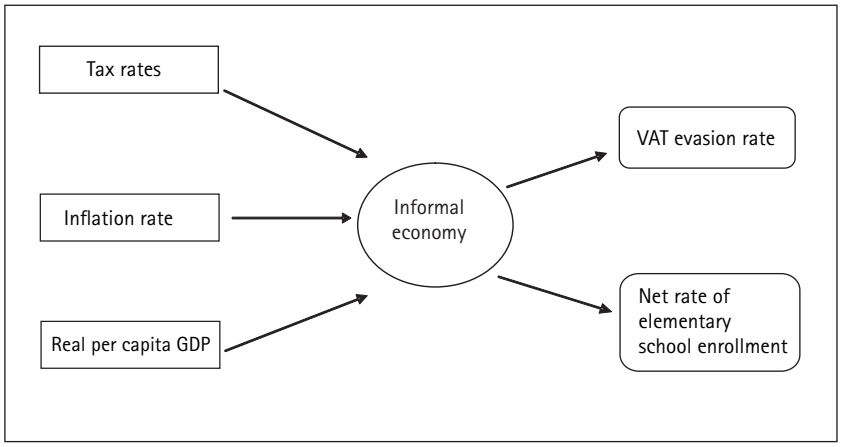
As noted earlier, in order to transform the results obtained through MIMIC model estimates provided in absolute magnitude; that is, in terms of percentages of GDP, a calculation is necessary for one of the years included. Thus, the estimate used was the one obtained by Hernández and De la Roca (2003): 37% of GDP for the year 2000, which is close to the estimate obtained by Vuletin (2008) of 38.1% in one of the years between

2000 and 2003. It was decided to use the calculation in the former study because it is specific to Peru (and for a particular year) and uses a direct method of measurement of the informal economy based on microeconomic data, such as the discrepancy between expenditure on consumption reported in the national accounts and that declared in household surveys.

5. THE SIZE OF THE INFORMAL ECONOMY

The criteria for selecting the estimated model are twofold. First, there must be convergence, given that the method used is of the highest likelihood. Second, it must be interpretable in an economically and statistically significant manner. The software used is Stata 12.0. The model that best fulfilled these two criteria includes three causes and two indicators. The causes are: the simple average marginal (maximal) rates of income tax rate (corporate and individual) and the VAT rate (normalized between 0 and 1),[19] the inflation rate, and real per capita GDP (normalized between 0 and 1).[20] The indicators are: the rate of VAT evasion and net rate of elementary enrollment. The model is shown in Graph 1 and the results are provided in Table 5.

Graph 1
MIMIC model for the calculation of the size of the informal economy in Peru



19. Both Loayza (1997) and Vuletin (2008) normalize the tax rates they use between 0 and 1.
20. This is done to homogenize scales and thus increase the occurrence of convergences in the process of econometric modeling for maximum credibility.

Table 5
Estimation of the standardized MIMIC model for the size of the informal economy in Peru

Causes of the informal economy			
Variable	Coefficient	Statistic z	P > |z|
Tax rate	0.2392	2.85	0.00
Inflation rate	0.3150	3.85	0.00
Real per capita GDP	- 0.7508	- 9.45	0.00
Indicator of the informal economy			
Variable	Coefficient	Statistic z	P > |z|
VAT evasion	0.9436	- [1]	- [1]
Net rate of elementary school enrollment	- 0.5028	- 3.86	0.00
Goodness-of-fit measures			
Likelihood ratio (estimated model versus saturated model)			$x^2 = 1.057$ $P > x^2 = 0.590$
RMSEA			0.000
Comparative adjustment index			1.000
Tucker-Lewis index			1.058
SRMR			0.033
Determination coefficient			0.913

Note:
[1] Since the value of 1 was imposed on this coefficient in the non-standardized model, it is not possible to perform a z test.

As can be seen, the estimated parameters have the expected signs and are statistically significant at 1%. For example, an increase in a standard deviation of real per capita GDP (the measure used for the aggregated productivity of the economy) reduces the size of the informal economy by 0.75 standard deviations. Similarly, an increase in the informal economy of one standard deviation reduces the net rate of elementary school enrollment by 0.50 standard deviations. All goodness-of-fit measures reported show that the estimated model fits the observed data quite well. In general, the statistical significance of the parameters and the goodness-of-fit of the model estimated are better than those obtained by Loayza (1997) and by Vuletin (2008).

Table 6 presents the relative estimated values and their corresponding absolute values (as a percentage of GDP), using as a reference the calculations of Hernández and De la Roca (2003) for the year 2000.

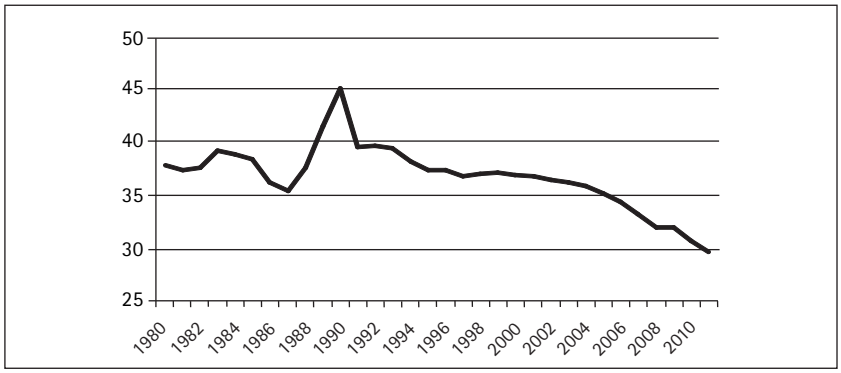
Table 6
Size of the informal sector, Peru, 1980–2011 (relative value and percentage of official GDP)

Years	Relative value	Official GDP (%)
1980	- 0.0421323	37.8
1981	- 0.0552300	37.4
1982	- 0.0472077	37.7
1983	0.0067187	39.3
1984	- 0.0037813	39.0
1985	- 0.0227320	38.4
1986	- 0.0940413	36.3
1987	- 0.1212589	35.5
1988	- 0.0486362	37.6
1989	0.0827761	41.5
1990	0.2059824	45.2
1991	0.0187602	39.6
1992	0.0214866	39.7
1993	0.0125026	39.4
1994	- 0.0308719	38.2
1995	- 0.0548729	37.4
1996	- 0.0576478	37.4
1997	- 0.0769663	36.8
1998	- 0.0678336	37.1
1999	- 0.0653120	37.1
2000	- 0.0708409	37.0
2001	- 0.0780405	36.8
2002	- 0.0874853	36.5
2003	- 0.0944269	36.3
2004	- 0.1055850	35.9
2005	- 0.1297108	35.2
2006	- 0.1594502	34.3
2007	- 0.1969385	33.2
2008	- 0.2419713	31.9
2009	- 0.2409264	31.9
2010	- 0.2840950	30.7
2011	- 0.3199484	29.6

Graph 2 shows the evolution of the magnitude of the informal economy. As can be seen, in 2011, it reaches the minimum value for the period, 29.6% of GDP. In contrast, the maximum value was 45.1% of GDP, recorded in 1990. These extreme values make sense since 2011 was a year preceded by a decade of accelerated growth (since 2002), with annual growth rates that fluctuated between 4% and 10% annually, with the exception of the abrupt deceleration observed in 2009 as a consequence of the international financial crisis. On the

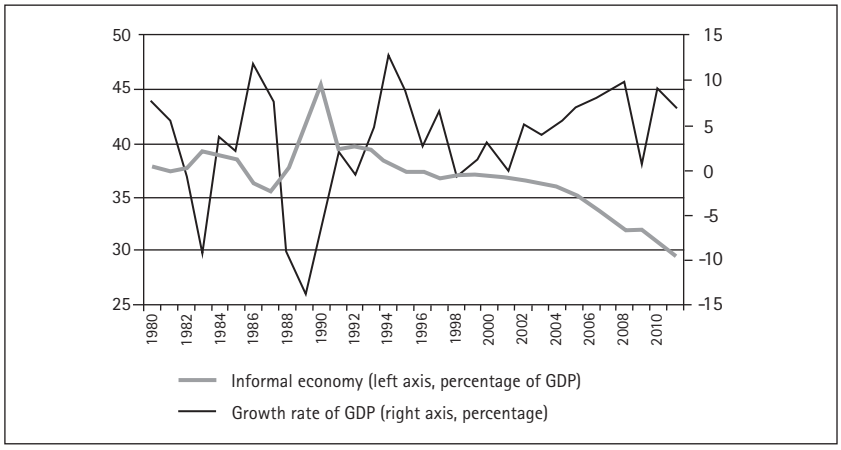
other hand, the peak reached by the informal economy in 1990 is explained by the severe economic crisis associated with the hyperinflation of 1988-1990, with decreases in the GDP of 9.4%, 13.4% and 5.1% in 1988, 1989 and 1990, respectively. This is illustrated in Graph 3. The coefficient of correlation between the size of the informal economy and the growth rate of the GDP in the period 1980-2011 is -0.5 and statistically significant to 1%. Thus, these results show that the informal economy is closely linked to economic crises.

Graph 2
Size of the informal economy, Peru, 1980-2011 (percentage of the GDP)



Sourse: Table 5.

Graph 3
Size of the informal economy and GDP growth rate, Peru, 1980-2011 (percentage of GDP and percentage)



Sourses: Table 5 and BCRP.

As mentioned in the introduction, an important issue that was not taken into account in previous studies has to do with the extent to which the products of the informal economy are captured by the official GDP. For example, how much of the 37% of GDP estimated by Hernández and De la Roca (2003) for the year 2000 was captured by official statistics? At one extreme, if the totality of the product of the informal economy is not captured in the calculation of the official GDP, then, in reality, the total GDP (official plus informal) is 37% higher than the official estimate. Thus, the product of informal economy 37/137 = 27% of total GDP (official plus informal). At the other extreme, if all the GDP of the informal economy is captured by the national accounts, its contribution is effectively the equivalent of 37% of total GDP.

It can be assumed that at least part of the product of the informal economy is captured in the calculation of the official GDP, because part of the income generated is transformed in expenditures in the formal economy. But, to this author's knowledge, no estimates for this are available for Peru or Latin America. Nevertheless, Schneider's (1998) study is often cited in this respect. He found that 66% of the income generated in the informal economy in Germany at the beginning of the 1990s was spent in the official economy. In the case of Peru, where the informal economy is larger than in Germany, it is probable that a lesser portion of the income generated in the informal economy is turned into expenditure in the official economy. It is probable that, because of its larger size, the informal economy creates a separate circuit that has weaker links to the formal economy. In the absence of additional information, a not so arbitrary assumption is that half of what is produced in the informal economy is incorporated into the official GDP. If this were the case, then the size of the informal economy in 2011 would have been 25.8% of total GDP, as shown in Table 7, which provides information on the size of the informal economy as a percentage of total official GDP (official plus informal) for various percentages of capture of informal GDP in the official GDP (the complete series is provided in Table A1 in the Appendix).

Table 7
Size of the informal economy, Peru, 1980–2011 (percentage of total GDP)

Year	Informal GDP captured in official GDP				
	0%	25%	50%	75%	100%
1980	27.4	29.5	31.8	34.6	37.8
1985	27.7	29.8	32.2	35.0	38.4
1990	31.1	33.7	36.8	40.6	45.2
1995	27.2	29.2	31.5	34.2	37.4
2000	27.0	28.9	31.2	33.8	37.0
2005	26.1	27.9	30.0	32.4	35.2
2010	23.5	24.9	26.6	28.5	30.7
2011	22.8	24.2	25.8	27.6	29.6

Another interesting exercise that can be carried out on the basis of these calculations is to combine them with those of Escobar (2008) in order to obtain the GDP of the illegal economy (smuggling and drug trafficking). This author estimates a time series for the subterranean economy in Peru for the period 1982-2005 by applying a Kalman filter to a state-space model.[21] Since the subterranean economy is the sum of the informal and the illegal economies, estimates of the aggregate value of activities associated with smuggling and drug trafficking can be obtained by difference. These calculations are shown in Table 8, in which the illegal economy reaches its maximum value in 1990, equivalent to 35.3% of GDP. In contrast, the minimum value was recorded in 1982, when the illegal economy was 16.3% of GDP. It is worth noting that both 1982 and 1990 were years of economic crisis. In the former case, this was because of the onset of the Latin American debt crisis, which was partially responsible for the drop in GDP of 0.3% and preceded a further decline of 9.3% in 1983 caused by the strong El Niño phenomenon that year. However, in contrast to the informal economy, the illegal economy may not be related to economic growth but rather to other variables.

Table 8
Size of the underground, informal and illegal economy in Peru, 1982–2009 (percentage of official GDP)

Year	Underground economy	Informal economy	Illegal economy (smuggling and drug trafficking)
1982	54.0	37.7	16.3
1985	72.0	38.4	33.6
1990	80.5	45.2	35.3
1995	71.5	37.4	34.1
2000	68.7	37.0	31.7
2005	67.5	35.2	32.3
2009	66.0[(1)]	31.9	34.1

Note:
[(1)] This observation corresponds to updates by Escobar (2008) available in Escobar (2010).
Sources: Escobar (2008), Table 5; compiled by the author.

21. The "state" is the situation of the system (model) of interest at a given moment. In any particular moment in time, the state is described through a set of variables that make up the "vector of the state." The state-space model is the space where successive vectors of state describe the system as a function of time. In the structural time series model (as described in equations (1) and (2) in the fourth section), the elements of the vector of the state are the non-observable components of the series. The Kalman filter estimates the non-observable state based on some observable variable related to it, so that the estimate is updated every time new information becomes available as time passes. For more details, see Escobar (2008).

These include world demand for narcotics and the intensity of operations against drug trafficking both in Colombia and in Peru, as well as measures against smuggling and the level of commercial barriers. As to the estimated size of the illegal economy, this has fluctuated approximately between 30% and 35% of GDP since 1990. In 2009, the last year for which information is available, the illegal economy reached 34.1% of official GDP. Once again, here we need to ask how illegal GDP is captured in the official GDP, and to this end a similar exercise to that shown in Table 7 for the informal economy can be carried out (Table A2 in the Appendix provides the complete time series).

6. DETERMINANTS OF THE INFORMAL ECONOMY

This section estimates an econometric model to identify the determinants of the informal economy in Peru, using the estimates calculated in the previous section. The candidates for explanatory variables are the same as were presented as possible causes in Table 4. The software package used is PcGive 10.1. The strategy of econometric modelling goes from the general to the particular; that is, it begins with an overparameterized model, consistent but inefficient, and gradually reduces the number of explanatory variables included in order to converge to a model that is still consistent but more efficient (Hendry and Doornik 2001). The results for the models selected are presented in Table 9.

Table 9
Identification of the determinants of the informal economy, 2Peru (dependent variable: Ln [added value of the informal economy in the official GDP])

Variable	Coefficient	Statistic z	P > |t|
Constant	1.4794	8.53(1)	0.00
Ln (real per capita GDP)	- 0.3054	- 15.2(1)	0.00
Ln (gross rate of tertiary education enrollment)	- 0.1100	- 10.4(1)	0.00
Ln (VAT rate)	0.0198	3.58(1)	0.00
Ln (1 + inflation)	0.0276	7.98(1)	0.00
Determination coefficient (R^2) = 0,9809			
AR 1-2 test		F(2,25) = 0.98	P-value = 0.3857
Normality test		x^2 (2) = 0.0970	P-value = 0.9527
Heteroskedasticity test		F(8,18) = 2.6783	P-value = 0.0394*
Heteroskedasticity test (with cross products)		F(1,26) = 2.2062	P-value = 0.0469*

Notes:
(1) Using standard errors consistent to heteroskedasticity.
* Statistically significant to 5%.

The four explanatory variables incorporated were found to display the expected signs. The R2 of 98% represents an excellent degree of adjustment, while the other statistics shown rule out any suspicion of problems relating to autocorrelation or non-normality of the errors. However, the presence of heteroskedasticity is suggested. For this reason, the t statistics of the estimated coefficients are constructed using standard errors consistent with heteroskedasticity. Despite this correction, the estimated coefficients are statistically significant to 1%.

The value of the estimated elasticities indicates that the decrease in the informal economy would be greater if the benefits of formality were increased, rather than by reducing the costs associated with it. Indeed, an increase in productivity would have the greatest impact: a 1% increase in the real per capita GDP would reduce the informal GDP/official GDP ratio by 0.31%. An increase in workers' capacities would have lesser though still significant impact; thus a 1% increase in the gross rate of tertiary education enrollment rate would reduce the ratio mentioned by 0.11%. In contrast, a 1% reduction in the VAT rate would reduce the product of the informal economy as a percentage of official GDP by only 0.02%. The reduction of the inflation rate would also have a small impact on the size of the informal economy.

As regards the variables that do not appear as explanatory in Table 9, two factors should be mentioned. First, neither the tax rate on corporate income, the tax rate on personal income, nor the average of these two rates – with or without the VAT rate – showed a statistically significant effect on the informal economy. This should come as no surprise, as presumably the vast majority of informal enterprises and own-account workers fall within a very low income range and thus would be largely exempt from income tax. Second, the minimum vital wage likewise did not show statistical significance in various specifications of the model. However, it is possible that other components of labor costs (social contributions, vacations, life insurance, compensation for years of service, etc.) or the rigidities of the labor market in general could have a significant effect of some kind on the size of the informal economy. The absence of data to construct a sufficiently long time series for Peru impedes the inclusion of a better measure of this aspect in the exercise of econometric modeling.

7. CONCLUSIONS

This study estimates a time series for the product of the informal economy – defined as the set of legal activities that create aggregate value, use cash in their transactions, do not pay taxes, and are not registered – in Peru as a percentage of official GDP for the period 1980-2011. In this sense, it contributes to the understanding of the evolution and

dynamics of this important sector over the last few decades, taking into account the fact that several previous studies only carried out point estimates of the phenomenon for a specific period of a year, two-years or three years. This time series permits an exploration of the determinants of the Peruvian informal economy in the future, which may be important to the design of public policies aimed at reducing informality in the national economy.

According to the estimates carried out, the informal economy in Peru fluctuated between values of 30% and 45% of GDP in the period analyzed. After reaching its highest level in 1990, it shrank over almost every year until 2011, when it reached its lowest level. These orders of magnitude are substantially lower than those estimated by Loayza (1997) for the beginning of the 1990s and by Schneider (2004) for the beginning of the 2000s, who calculated the size of the informal economy as close to 60% of GDP. However, these two authors estimated the size of the informal economy in the framework of a cross-section series, including a set of countries other than Peru. In contrast, the values calculated in this study appear more in line with those of Vuletin (2008) for the beginnings of the 2000s, and of Hernández and De la Roca (2003) for the year 2000. The latter is obvious, since it was Hernández and De la Roca's results that were used as a reference to convert relative values estimated by the MIMIC method into values of percentages of GDP . This was selected because the study cited is based on a direct method of measurement that draws on the discrepancy in consumption expenditures registered in the national accounts, as well as the discrepancy arising from the National Living Conditions Survey (Encuesta Nacional de Niveles de Vida, ENVIV) carried out in May 2000 by the Instituto Cuánto.

One point that is rarely taken into account in analyses of this type has to do with the percentage of informal GDP captured by the official GDP. It is implicitly assumed that none of the informal GDP is captured. Nevertheless, studies on other countries have found that a large portion of the income generated in the informal economy is spent in the formal economy and is therefore captured in official statistics. This is important, given that, for example, if we assume that 50% of the informal sector is captured by the official GDP, then in 2011 the informal GDP would have reached 25.4% of total GDP (official plus informal) versus the 29.6% estimated, assuming that none of the aggregate value generated in the informal economy is included in the national accounts. It is worth noting that the results obtained in this work are consistent with those of Escobar (2008) for the underground economy in 1982-2005, which includes the informal economy and the illegal economy (smuggling and drug trafficking).

When exploring the determinants of the informal economy in Peru, the econometric results indicate that the factors that have the greatest impact on the reduction of the informal economy are linked to increases in the benefits associated with formality rather

than the reduction of the costs associated with formality. This explains the low impact of the MSME law that has been in force since mid-2013, since it concentrates on providing incentives by way of cost reductions rather than on increasing and demonstrating the benefits of formality.

In particular, the greatest impact on the reduction of the informal economy would result from an increase in the aggregate productivity of the economy (measured by real per capita GDP), followed by the increase in the capacities of workers (measured by the gross rate of tertiary education enrollment). The impact of the reduction of costs would be much smaller and would be concentrated on reductions in the VAT rate, given that the rates of personal income taxes and corporate taxes have little impact on the informal economy. This explains why, presumably, the majority of microenterprise and own-account workers have very low levels of income and would therefore be exempt from the payment of income tax. Similarly, the reduction of the minimum living wage would also not generate a significant reduction in the informal economy.

Consequently, the econometric results have implications for policies that promote the formalization of economic activity, suggesting the need to concentrate on increasing the benefits associated with formality. This includes policies and programs for increasing productivity and the quality of products and processes, greater access to markets and to internationalization, and improvement in the quality of education and the training of workers.

BIBLIOGRAPHY

CEPAL
2012 *Panorama social de América Latina y el Caribe 2012.* Santiago: CEPAL.

CHACALTANA, Juan
2008 "Una evaluación del régimen laboral especial para la microempresa en Perú, al cuarto año de vigencia." Working document. Lima: Organización Internacional del Trabajo (OIT).

CHONG, Alberto; José GALDO and Jaime SAAVEDRA
2008 "Informality and Productivity in the Labour Market in Peru." In: *Journal of Economic Policy Reform,* vol. 11, N° 4, pp. 229-245.

DE LA ROCA, José; Manuel HERNÁNDEZ, Miguel ROBLES, Máximo TORERO and Maureen WEBBER
2002 "Informal Sector Study for Jamaica." Grade/International Development Bank (IDB). Manuscript.

DE PAULA, Áureo and José. A. SCHEINKMAN
2007 "The Informal Sector." Working document 13486. Cambridge: National Bureau of Economic Research.

DE SOTO, Hernando
1986 *El otro sendero.* Lima: Editorial El Barranco.

ESCOBAR, José Manuel
2010 "Economía subterránea ¿Cómo vamos?" Blog by José Manuel Escobar Montalvo. Retrieved on: 06/2012. <http://josemanueles.blogspot.com/2010/02/economia-subterranea-como-vamos.html>.
2008 "Una medición de la economía subterránea peruana a través de la demanda de efectivo: 1980-2005." Lima: Consorcio de Investigación Económica y Social (CIES).

HECKMAN, James J.
1979 "Sample Selection Bias in as a Specification E." In: *Econometrica,* vol. 47, pp. 153-161.

HECKMAN, James J.; Hidehiko ICHIMURA and Petra E. TODD
1997 "Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme." In: *Review of Economic Studies,* vol. 64, N° 4, pp. 605-654.

HENDRY, David F. and Jurgen DOORNIK
2001 *Empirical Econometric Modelling Using PcGive Volume I.* London: Timberlake Consultants Ltd.

HERNÁNDEZ, Manuel and Jorge DE LA ROCA
2003 "Evasión tributaria e informalidad en el Perú: una aproximación a partir del enfoque de discrepancias en el consumo." Lima: ACDI-IDRCI.

HIRSCHMAN, Albert O.
1970 *Exit, Voice and Loyalty.* Cambridge, MA: Harvard University Press.

KAUFMANN, Daniel and Aleksander KALIBERDA
1996 "Integrating the Unofficial Economy into the Dynamics of Post Socialist Economies: A Framework of Analyses and Evidence." Working document. Policy Research 1691. Washington, DC: World Bank.

LACKÓ, Mária
1997 "Do Power Consumption Data tell the Story? Electricity Intensity and the Hidden Economy in Post-socialist Countries." Working document. Luxemburg: IIASA.

LEE, Lung-Fet
1978 "Unionism and Wage Rates: A Simultaneous Equation Model with Qualitative and Limited Dependent Variables." In: *International Economic Review,* vol. 19, pp. 415-433.

LOAYZA. Norman A.
1997 "The Economics of the Informal Sector: A Simple Model and Some Empirical Evidence from Latin America." Working document. Policy Research 1727. Washington, DC: World Bank.

LOAYZA, Norman A. and Jamele RIGOLINI
2006 "Informality Trends and Cycles." Working document. Policy Research WPS 4078. Washington, DC: World Bank.

MALONEY, William F.
2003 "Informality Revisited." Working document. Policy Research WPS 2695. Washington, DC: World Bank.

MINISTERIO DE LA PRODUCCION and CODEMYPE.
2011 *Estadísticas. Micro y pequeña empresa 2010.* Lima: Dirección General de MYPE and Cooperativas-Ministerio de la Producción.

PERRY, Guillermo E.; William M. MALONEY; Omar S. ARIAS; Pablo FAJNZYLBER; Andrew D. MASON and Jaime SAAVEDRA-CHANDUVÍ
2007 *Informalidad: escape y exclusión. World Bank studies on Latin America and the Caribbean.* Washington: Banco Mundial.

RAMA, Martin
1995 "Do Labor Market Policies and Institutions matter? The Adjustment Experience in Latin America and the Caribbean." Washington: World Bank. Manuscript.

SAAVEDRA, Jaime
1999 "La dinámica del mercado de trabajo en el Perú antes y después de las reformas estructurales." Working document. Serie Reformas Económicas, N° 27. Santiago: CEPAL.

SAAVEDRA, Jaime and Alberto CHONG
1999 "Structural Reforms, Institutions and Earnings: Evidence from the Formal and Informal Sectors in Urban Peru." In: *Journal of Development Studies,* vol. 35, pp. 95-116.

SCHNEIDER, Friedrich
2004 "The Size of the Shadow Economies of 145 Countries all over the World: First Results over the Period 1999 to 2003." Discussion paper, IZA N° 1431. Bonn: Institute for the Study of Labor.
1998 "Further Empirical Results of the Size of the Shadow Economy of 17 OECD Countries Over Time." Discussion paper. Linz: Department of Economics, University of Linz.

SCHNEIDER, Friedrich and Dominik H. ENSTE
2000 "Shadow Economies: Size, Causes, and Consequences." In: *Journal of Economic Literature,* vol. XXXVIII, pp. 77-144.

VERDERA, Fernando
1994 "Seguridad social y pobreza en el Perú: una aproximación." Working document. Serie Economía N° 84. Lima: Instituto de Estudios Peruanos (IEP).

VILLARÁN, Fernando
2000 "Las PYMEs en la estructura empresarial peruana." Lima: SASE.

VULETIN, Guillermo
2008 "Measuring the Informal Economy in Latin America and the Caribbean." Work document, IMF WP/08/102. Washington, DC: International Monetary Fund (IMF).

YAMADA, Gustavo
1996 "Urban Informal Employment and Self Employment in Developing Countries: Theory and Evidence." In *Economic Development and Cultural Change,* vol. 44, N° 2, pp. 289-313.

Databases

World Bank http://databank.worldbank.org/data/home.aspx
BCRP http://www.bcrp.gob.pe/estadisticas/cuadros-anuales-historicos.html
INEI http://www.inei.gob.pe/
MEF http://www.mef.gob.pe/
ONP http://www.onp.gob.pe
SBS http://www.sbs.gob.pe/app/stats/EstadisticaBoletinEstadistico Hist.asp?p=36#
SUNAT http://www.sunat.gob.pe/estadisticasestudios/principales_tasas/compendio_tasas_impositivas.xls

APPENDIX

Table A1
Size of informal economy, Peru, 1980–2011 (percentage of total GDP)

Year	Informal GDP captured in the official GDP				
	0%	25%	50%	75%	100%
1980	27.4	29.5	31.8	34.6	37.8
1981	27.2	29.2	31.5	34.2	37.4
1982	27.4	29.4	31.7	34.4	37.7
1983	28.2	30.3	32.8	35.8	39.3
1984	28.0	30.1	32.6	35.5	39.0
1985	27.7	29.8	32.2	35.0	38.4
1986	26.6	28.5	30.7	33.3	36.3
1987	26.2	28.0	30.1	32.6	35.5
1988	27.3	29.3	31.7	34.4	37.6
1989	29.3	31.7	34.4	37.6	41.5
1990	31.1	33.7	36.8	40.6	45.2
1991	28.4	30.5	33.1	36.1	39.6
1992	28.4	30.6	33.1	36.1	39.7
1993	28.3	30.4	32.9	35.9	39.4
1994	27.6	29.7	32.0	34.8	38.2
1995	27.2	29.2	31.5	34.2	37.4
1996	27.2	29.2	31.5	34.2	37.4
1997	26.9	28.8	31.1	33.7	36.8
1998	27.0	29.0	31.3	33.9	37.1
1999	27.1	29.0	31.3	34.0	37.1
2000	27.0	28.9	31.2	33.8	37.0
2001	26.9	28.8	31.1	33.7	36.8
2002	26.7	29.0	30.9	33.4	36.5
2003	26.6	29.0	30.7	33.3	36.3
2004	26.4	28.3	30.5	33.0	35.9
2005	26.1	27.9	30.0	32.4	35.2
2006	25.6	27.3	29.3	31.6	34.3
2007	24.9	26.6	28.5	30.7	33.2
2008	24.2	25.7	27.5	29.5	31.9
2009	24.2	25.8	27.5	29.6	31.9
2010	23.5	24.9	26.6	28.5	30.7
2011	22.8	24.2	25.8	27.6	29.6

Table A2
Size of underground, informal and illegal economies in Peru, 1982–2009 (percentage of official GDP)

Year	Underground	Informal economy	Illegal economy (smuggling and drug trafficking)
1980	n. d.[1]	37.8	n. d.
1981	n. d.	37.4	n. d.
1982	54.0	37.7	16.3
1983	60.2	39.3	20.9
1984	66.3	39.0	27.3
1985	72.0	38.4	33.6
1986	71.2	36.3	34.9
1987	67.1	35.5	31.6
1988	65.0	37.6	27.4
1989	72.4	41.5	30.9
1990	80.5	45.2	35.3
1991	73.4	39.6	33.8
1992	70.3	39.7	30.6
1993	72.6	39.4	33.2
1994	72.9	38.2	34.7
1995	71.5	37.4	34.1
1996	70.7	37.4	33.3
1997	70.8	36.8	34.0
1998	70.1	37.1	33.0
1999	69.4	37.1	32.3
2000	68.7	37.0	31.7
2001	68.2	36.8	31.4
2002	66,2	36.5	29.7
2003	66,1	36.3	29.8
2004	66.5	35.9	30.6
2005	67.5	35.2	32.3
2006	67.0[2]	34.3	32.7
2007	66.0[2])	33.2	32.8
2008	65.0[2]	31.9	33.1
2009	66.0[2]	31.9	34.1
2010	n. d.	30.7	n. d.
2011	n. d.	29.6	n. d.

Notes:
[1] Undetermined.
[2] Observations corresponding to updates carried out by Escobar (2010).
Sources: Escobar (2008), Table 5; compiled by the author.