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INFORMAL EMPLOYMENT IN RURAL AREAS: A CONCEPTUAL FRAMEWORK FOR COMPLEX ECONOMIC-MATHEMATICAL MODELING

Saidov Nurali

Tashkent State University of Economics

n.saidov@tsue.uz

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Abstract: Informal employment remains a persistent structural feature of rural labour markets in developing economies, yet efforts to reduce it are often hampered by the absence of an integrated analytical framework linking its determinants to formal modeling tools. This paper aims to transform the qualitative understanding of rural informal employment into a conceptual framework suitable for complex economic-mathematical modeling. Using a systematic literature review and a comparative-analytical method, the study synthesises four theoretical approaches to informality and reorganises its determinants into a four-block system of explanatory variables: economic, institutional, socio-demographic and territorial. On this basis, a three-stage conceptual framework is proposed, connecting the factor blocks (input), the modeling core (logit/probit and panel specifications), and the output (probability and level of informal employment, policy scenarios). The framework provides a methodological foundation for subsequent econometric estimation and for designing targeted, region-specific policies to reduce informal employment in rural areas.

Keywords: informal employment, rural labour market, economic-mathematical modeling, explanatory variables, logit/probit models, panel data, Uzbekistan.

1. Introduction

Informal employment is one of the most persistent structural characteristics of labour markets in developing economies, and it is consistently more prevalent in rural areas than in cities. In Uzbekistan, where a large share of the population lives in rural areas and labour resources grow rapidly, agriculture has traditionally been one of the largest sources of seasonal and informal employment [1]. Official statistics confirm the scale of the phenomenon: in 2024, the share of the non-observed (informal and hidden) economy in gross domestic product reached 34.8 per cent, and within its sectoral structure the largest share, 63.6 per cent, belonged to agriculture, forestry and fishing [2]. This indicates that informal economic activity in Uzbekistan is heavily concentrated in the rural sector.

A substantial body of literature explains the nature and determinants of informal employment. The classical theoretical schools, namely the dualist [3], structuralist [4], legalist [5] and voluntarist [6] approaches, clarify why informality emerges, while empirical studies increasingly quantify its determinants using discrete-choice and panel methods. Recent econometric work confirms that education, income, economic sector, age, gender and rural residence are significant determinants of informality across diverse contexts, estimated through logit, probit and multinomial logit models [7, 8, 9].

Despite this progress, a gap remains. The determinants of rural informal employment are well documented in narrative form, but they are rarely organised into an integrated, model-ready system

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that connects theory directly to formal economic-mathematical specification. In particular, the specific forms and factors of rural informal employment are seldom presented as a coherent set of explanatory variables suitable for complex modeling.

This gap is especially important for rural areas, where informal employment differs structurally from its urban counterpart. Rural informality is shaped by the predominance of small-scale agrarian production, the seasonality of agricultural work, the limited capacity of the formal sector, high rates of labour migration, and the weak coverage of financial and administrative institutions [1]. As a result, in rural areas informality is frequently not a marginal phenomenon but the only available form of employment, which makes it systemic and resistant to purely prohibitive measures. A model intended to inform rural policy must therefore reflect this specificity through an appropriate set of explanatory variables rather than borrow an undifferentiated urban specification.

Accordingly, the aim of this paper is to develop a conceptual framework that transforms the qualitative understanding of rural informal employment into a structure suitable for complex economic-mathematical modeling. The study addresses three research questions: (RQ1) which theoretical and empirical approaches are most suitable for modeling rural informal employment; (RQ2) how the determinants of rural informal employment can be systematised into blocks of explanatory variables; and (RQ3) how these blocks can be integrated into a unified modeling framework.

2. Materials and Methods

The study employs a qualitative, theoretical-analytical research design. Four methods are applied: a systematic literature review, to identify theoretical approaches and empirical modeling practices; a comparative-analytical method, to compare modeling techniques (logit, probit, panel) and their applicability to rural data; classification and typology, to group determinants into blocks of explanatory variables; and a systems approach, to integrate these blocks into a single conceptual framework.

The information base comprises three groups of sources: international theoretical literature on informality [3, 4, 5, 6]; recent empirical studies applying econometric models to informal employment [7, 8, 9]; and national sources, including scholarly works on the rural labour market of Uzbekistan [1] and official statistical data [2]. Only open and verifiable sources were used. As the study is conceptual, it does not estimate an empirical model; rather, it specifies the framework within which such estimation can subsequently be carried out.

3. Results

3.1. Theoretical and methodological foundations for modeling

Modeling rural informal employment requires a synthesis of theory and empirical technique. Theoretically, the four schools are complementary rather than competing: the dualist approach explains informality as a survival mechanism arising from the limited capacity of the formal sector [3]; the structuralist approach treats formal and informal sectors as interconnected [4]; the legalist approach interprets informality as a rational response to the high costs of formalisation [5]; and the voluntarist approach shows that part of informal employment reflects a voluntary choice for flexibility [6]. For rural areas, the dualist and structuralist logics dominate, while institutional and voluntary factors remain relevant.

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Methodologically, the empirical literature offers well-established tools. Binary discrete-choice models (logit and probit) estimate the probability that an individual is informally employed as a function of explanatory variables [7, 8]. Multinomial logit models extend this to several employment states, for example self-employment, casual labour and wage employment [9]. Panel data models capture the persistence of informality over time and across regions. These techniques share a common requirement: a well-specified set of explanatory variables. This is precisely where a rural-specific factor system is needed.

3.2. Forms of rural informal employment as modeling states

Before specifying explanatory variables, the phenomenon to be modeled, that is the dependent variable, must itself be defined. Rural informal employment is not homogeneous; it comprises several forms that differ in their economic nature: self-employment in dehqon (peasant) and household plots; unpaid family labour in unregistered family enterprises; seasonal employment tied to the agricultural calendar; casual or one-off day labour; unregistered trade, crafts and personal services; and informal employment linked to external labour migration [1]. Empirical evidence indicates that external labour migration and agrarian self-employment account for the largest shares of rural informal employment [1].

This heterogeneity has a direct modeling implication. When informal employment is treated as a single binary outcome (informal versus formal), a logit or probit model is appropriate. When the distinct forms above are of interest, the dependent variable becomes categorical, and a multinomial logit model is required to distinguish, for example, self-employment, casual labour and migration-related informality as separate states [9]. The choice of the dependent-variable structure therefore follows directly from the forms identified here, and it determines the modeling core described below.

3.3. A four-block system of explanatory variables

Building on the systematisation of determinants, the factors of rural informal employment can be organised into four blocks, each corresponding to a distinct block of explanatory variables in a model specification (Table 1).

Table 1
Four-block system of explanatory variables for modeling rural informal employment

Block	Determinants (variables)	Illustrative measurement indicators
Economic	shortage of formal jobs; income level; poverty; financial access	formal-job density; average wage; poverty rate; credit access index
Institutional	formalisation procedures; tax burden; legal literacy	registration cost/time; effective tax rate; legal-awareness index
Socio-demographic	age; education; occupational skills; migration	age; years of schooling; skill level; migration status
Territorial	infrastructure; distance to markets; transport	infrastructure index; distance to market; transport availability

Source: compiled by the author on the basis of [1].

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Each block enters the model as a thematic group of regressors. This structure has two advantages: it ensures that the specification is theoretically grounded, since each variable maps to a recognised determinant, and it allows the relative contribution of each block to be assessed separately, which is essential for targeted policy design.

3.4. The proposed conceptual framework

Integrating the elements above yields a three-stage conceptual framework for modeling rural informal employment.

The first stage is the input: the four blocks of explanatory variables (economic, institutional, socio-demographic, territorial), measured at the individual, household or regional level.

The second stage is the modeling core: a logit or probit model estimating the probability of informal employment and, where several states are distinguished, a multinomial logit, complemented by a panel specification capturing regional and temporal persistence.

Formally, in the binary case the probability that unit i is informally employed can be expressed as a function of the four variable blocks: $P(\text{Informal} = 1) = F(\beta 0 + \beta 1 \cdot ECON_i + \beta 2 \cdot INST_i + \beta 3 \cdot SOCDEM_i + \beta 4 \cdot TERR_i + \varepsilon_i)$, where F is the logistic (logit) or normal (probit) link function; ECON, INST, SOCDEM and TERR denote the vectors of economic, institutional, socio-demographic and territorial variables from Table 1; β are the coefficients to be estimated; and ε is the error term. In the panel form, region and time indices are added to capture persistence and unobserved regional heterogeneity. The operationalisation of informal employment itself follows the international statistical definition, which identifies informality through the nature of the job and the absence of social protection [10], ensuring that the dependent variable is measured consistently and comparably.

The third stage is the output: the estimated probability and level of informal employment by region, the marginal effects of each variable block, and the simulation of policy scenarios, for example the effect of reducing formalisation costs or creating formal jobs. Because the factor blocks are explicit, the framework allows policy to be made region-specific, as interventions can target the block that contributes most to informality in a given territory.

This framework directly connects the conceptual analysis of rural informal employment to its formal quantification, thereby providing the analytical backbone for the complex economic-mathematical models to be developed in the subsequent stage of the research.

4. Conclusion

The paper has developed a conceptual framework that transforms the qualitative understanding of rural informal employment into a structure suitable for complex economic-mathematical modeling. Three main conclusions follow. First, the four theoretical approaches and the established discrete-choice and panel techniques are complementary and jointly provide a sound basis for modeling rural informal employment. Second, the determinants of rural informal employment can be systematised into four blocks (economic, institutional, socio-demographic and territorial), each corresponding to a block of explanatory variables. Third, these blocks can be integrated into a three-stage framework (input, modeling core and output) that links theory to formal specification and enables region-specific policy analysis.

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The main limitation of the study is that it is conceptual: the framework is not yet empirically estimated. This defines the direction of further research, namely the collection of individual, household and regional data and the empirical estimation of the specified models for the rural areas of Uzbekistan.

From an applied perspective, the framework offers two practical benefits. It supports the construction of a regional monitoring tool in which the estimated probability of informal employment is tracked across territories, and it enables scenario analysis, allowing policymakers to compare the expected effect of alternative interventions, such as reducing formalisation costs, creating formal jobs, or organising labour migration, before implementation. In this way, the proposed framework links the theoretical understanding of rural informal employment to evidence-based, region-specific policy design and constitutes the analytical foundation for the complex economic-mathematical models to be built in the next stage of the project.

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