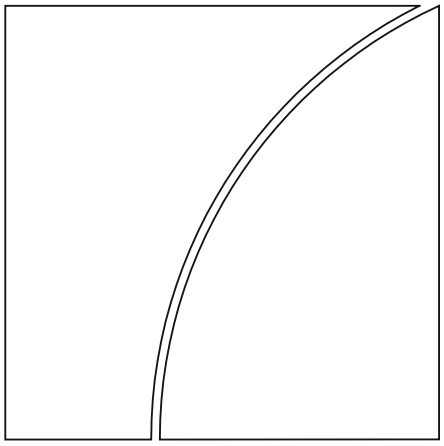

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# Financial inclusion transitions in Peru: Does labor informality play a role?*

Jose Aurazo† Farid Gasmi‡

July 2024

**Abstract**

Low financial inclusion and high labor informality are two major challenges in developing countries. Using Peruvian survey data from 2015-18, we explore the dynamic relationship between these two variables by examining how labor informality and movements between formal and informal jobs may affect the transition probabilities of financial inclusion. First, we find that becoming informally employed reduces the probability of entering the formal financial system by 8 percentage points (pp) and increases the likelihood of exiting from it by 9.3 pp. Relative to persistently informal workers, those who stay in formal jobs have a 9 pp higher probability of gaining access to bank accounts, and 12 pp lower probability of losing access. Workers who move into formal jobs are more likely to enter the formal financial system by 9.7 pp and less likely to exit from it by 7.1 pp. These results underscore the complementarity of formalizing the informal sector and expanding access to financial services.

**Keywords**: Financial inclusion, labor informality, transition probabilities, dynamic random-effect panel probit.

**JEL Classification**: C23, D14, E26, I31, O17

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# 1 Introduction

In recent years, financial inclusion (FI) has become a prominent policy goal in countries around the world. FI is generally understood as the extent of access at affordable cost to financial services provided by formal financial intermediaries, including payments, savings, credit, and insurance (Carbo et al., 2005; Barajas et al., 2020).[1] The importance of FI for emerging markets and developing economies (EMDEs) lies in the benefits it provides to the poor and most vulnerable in society by increasing productivity and growth and by fostering the transition to a digital economy (Aguilar et al., 2024; Ahmad et al., 2023; Abdul Karim et al., 2022; Kebede et al., 2023; Hu et al., 2021; Siddiki and Bala-Keffi, 2024; Wang et al., 2023).[2]

Especially central banks are getting more involved in the promotion of FI as one of their main policy goals. Kosse and Mattei (2023) find that a key motivation for central banks to explore innovations in payments, particularly in EMDEs, is to increase the access to financial services.[3] In many cases, central banks have a financial inclusion mandate and/or take part in forums or initiatives to promote FI, eg as a part of national payment strategies (Central Bank of Kenya, 2022). Monetary policies become more effective with higher levels of FI as more people can save or request loans according to changes in interest rates (Mehrotra and Yetman, 2014; Prasad, 2014; Hannig and Jansen, 2010; Galí et al., 2004) and it can also favour financial stability (Feghali et al., 2021; Wang and Luo, 2022).

FI may depend on another key feature of EMDEs, namely labor informality (LI).[4] There are at least five reasons for this relationship. First, workers with formal jobs may perceive a direct benefit of possessing a bank account, namely, to receive their salary transfer as an account is often required by the employer. Second, workers with informal jobs typically operate in cash-based ecosystems and may view opening a bank account only as a burden. Third, employers themselves may benefit from operating "under the table" in such ecosystems, as it is less traceable for tax control authorities. Fourth, to open an account, formal workers may incur less costs than informal workers, as both the opening procedure and cash deposits are usually carried out by employers. Last but not least, for security reasons, informal workers are less likely to travel to an automated teller machine (ATM) or visit a bank agent or branch to deposit cash funds.[5]

This paper aims to analyze the relationship between FI and LI from a dynamic perspective, ie how LI and movements between formal and informal employment affect the probability of FI transitions (ie entry to and exit from the financial system). In this regard, the existing literature is, to our knowledge, non-existent. While it is important to analyze the key drivers of an individual's decision

[1] Although we are aware that financial inclusion comprises several dimensions (access, use, quality, and affordability) – and is thus a broad concept –, this paper addresses a narrower concept of FI as the access to (ownership of) bank accounts and payment cards such as debit and credit cards. Therefore, the reader should understand the term being financially included as gaining access to bank accounts and/or payment cards, or entering the formal financial system.

[2] Access to accounts has risen over time but gaps remain in EMDEs. In 2021, while 76% of the global adult population had an account with a financial institution or use mobile money services, close to 71% of population were banked in developing countries (Demirgüc-Kunt et al., 2022).

[3] Central banks are working on two payment innovations, namely, central bank digital currencies (CBDCs) and fast payment systems. Both can be designed in ways to promote FI. See Boakye-Adjei et al. (2022) and Aurazo et al. (2024).

[4] LI means employment without formal work contract, social security coverage, etc. In Peru, 75% of employees are informal. See Hart (1973) for a seminal discussion of informal employment in Ghana.

[5] In addition, LI could limit the access to and use of other financial/payment products such as credit cards as banks usually ask for a proof of stable income when providing credit lines. The benefits from being able to use digital payment instruments linked to a bank account may lose their relevance for informal workers as making transactions with cash is the rule rather than the exception for them.

whether to be financially included in a given period, it is at least as important to understand the dynamic process of entering and exiting from the financial system. In fact, from a policy perspective, in particular for EMDEs, what really matters is the stability of FI, ie that individuals decide to be financially included and stay that way over time.

The objective of this paper is to document key facts and open a new venue of research on financial inclusion. Indeed, other economic phenomena such as income poverty (Bettin et al., 2022), energy poverty (Alem and Demeke, 2020; Drescher and Janzen, 2021) or unemployment (Biewen, 2009) are treated as dynamic processes. We then introduce the dynamics of LI, analyzing how LI and its transitions (ie one-year movements between formal and informal jobs) affect the probability of entering and exiting from the financial system. We use a dynamic random-effect panel data probit model to test genuine state dependence of FI.

Our country of interest is Peru, which is one of the least advanced countries in Latin America in terms of FI and one of the countries with the highest degree of LI. In Latin America and the Caribbean (LAC), 51% of adults had an account in 2014 and 54% in 2017. In Peru this was only 29% in 2014 and 43% in 2017. This puts Peru above El Salvador, Nicaragua, and Haiti with 31%, and Mexico with 37% but below Brazil, Chile, and Colombia. Still, Peru has significantly increased its FI level over the last years. In 2015, 7.2 million people over 18 years old, which represented 35% of the working-age population, had at least one account or payment card. In 2018, these figures increased to 8.7 million and 40% respectively. Meanwhile, in 2018, Peru's shadow economy represented around 45% of the country's total economic activity (Medina and Schneider, 2018) and, according to official reports, close to 75% of the working-age population had persistently informal jobs over the last decade.

We analyze a longitudinal sample that we extracted from the *Encuesta Nacional de Hogares* (National Survey of Households), which is a nationally representative survey conducted between 2015 and 2018 in Peru. We find evidence of state dependence of FI that follows an auto-regressive process, ie past status of FI affects its current state. We also find that LI reduces the probability of entering the formal financial system by around 8.0 percentage points (pp). It increases the probability of exiting from it by around 9.3 pp. As to the dynamics of the LI-FI relationship, our results suggest that, relative to workers who stay in informal jobs (the majority of the Peruvian workforce), those who remain with formal jobs see their probability of gaining access to bank accounts and payment cards increased by 9 pp. Their probability of losing it is reduced by 12 pp. For those who move into LI, they are more likely to enter the formal financial system by 9.7 pp and less likely to close their bank accounts and payment cards by 7.1 pp, relative to our base category. Our results are robust to alternative specifications which contains only individual controls, and individual and household characteristics.

The rest of the paper is organised as follows. In section 2, we review some pieces of research that are related to our work. This includes some empirical papers on the determinants of FI and studies that estimate transition probabilities to analyze the dynamics of economic phenomena such as poverty or unemployment. In section 3, we describe the Peruvian data and some descriptive evidence. In section 4, we introduce our econometric strategy, and in section 5 we discuss the results. In section 6, we conclude by summarising key insights and policy implications, and sketching avenues for future research.

## 2 Related literature

Our work is directly related to the literature on the determinants of FI. It is indirectly related to literature on the dynamics of economic phenomena such as poverty and unemployment that estimate transition probabilities. We review these two strands of research in turn.

### 2.1 The determinants of financial inclusion

FI may be thought of in two ways. A broad definition is that individuals and businesses have access to useful and affordable financial products and services, such as payments, savings, credit and insurance, that meet their needs.[6] A narrow definition of FI merely is that adults and businesses have access to banking accounts and/or payment instruments such as payment cards. The latter is the focus of our paper. In this narrow sense, FI is the first step towards access to digital payments, replacing less efficient methods such as cash (Aurazo and Vega, 2021).

Furthermore, FI is considered an effective gateway for broader financial services (Committee on Payment and Market Infrastructures and World Bank Group, 2016). In the US, Shy (2020) shows that low-income people are mostly unbanked and do not use debit or credit cards. Studies show that access to bank accounts and debit instruments can stimulate savings (Bachas et al., 2021; Dupas et al., 2018). Other papers focus on the importance of financial inclusion for energy poverty (Koomson and Danquah, 2021; Dogan et al., 2021) and environmental benefits (Shahbaz et al., 2022).

In recent years, FI has aroused the interest of multilateral organisations, policymakers, and academics around the world. In 2011, the Maya Declaration, set out by the Group of Twenty (G20), called for global efforts to advance FI worldwide so as to reduce poverty and promote financial stability. Many governmental authorities, especially in EMDEs, have since implemented national FI strategies that involve both private and public entities, including central banks (Morales-Resendiz et al., 2021). Moreover, multilateral organisations have developed a set of surveys to monitor the degree of FI around the planet as in the case of the World Bank Global Findex databases (Demirgüç-Kunt et al., 2022).[7]

The importance of FI for alleviating poverty and promoting innovation, in particular, by digitising a key sector of the economy is widely recognised. Yet, improving the means to measure it and to identify its determinants still occupies a large part of researchers' agendas. Tram et al. (2021) construct a composite financial inclusion index for developing countries that incorporates three dimensions, namely penetration, availability and use of financial services, including mobile money. Some studies have examined the individual determinants of financial inclusion. Allen et al. (2016) explore the individual and country characteristics that allow effective policies to promote financial inclusion among the most vulnerable populations, they find that the likelihood of having an account is greater for richer, more educated, older, urban, employed, married or separated individuals. In addition, a greater level of financial inclusion is associated with lower account costs, greater proximity to financial intermediaries, stronger legal rights and more politically stable environments.

Along these lines, Fungacova and Weil (2015) find results showing that income level, education and age are associated with a higher probability of being financially included in China while Zins and Weil (2016) find that being a man, richer, more educated and older favour FI in Africa with a stronger effect of education and income. In the US, Hayashi and Minhas (2018) find that low-income

[6] See `https://www.worldbank.org/en/topic/financialinclusion/overview#1`.

[7] The Global Findex databases are public and can be accessed at `https://globalfindex.worldbank.org/`.

households without internet access are much more likely to be unbanked than those with internet access. Likewise, a few papers on specific EMDEs such as Argentina (Tuesta et al., 2015), Mexico (Martinez and Woodruff, 2009), Colombia (Murcia, 2007), Brazil (Kumar, 2005) and Pakistan (Nenova et al., 2009) use national surveys or the Global Findex. They find that individual-related variables such as household income, educational level, geographical area, gender, property rights, distrust, consumption habits and experience of past shocks, among others, are significant determinants of access to and/or use of financial products.

For the case of Peru, our country of interest, Alfageme and Ramirez-Rondán (2018) and Aurazo and Vega (2021) have analyzed the determinants of FI at the household level and individual level, respectively. Alfageme and Ramirez-Rondán (2018) find a positive relationship between FI and income, education and age of the head of the household and a negative relationship with the fact the household lives in rural areas and is poor. Aurazo and Vega (2021) consider FI a necessary step for using digital payments so as to overcome a problem of selection bias. They find that, among other things, labor informality decreases the probability of having an account, a debit card or a credit card. In fact, although it is well-recognised that the informal sector and financial exclusion are related, only a few papers have analyzed the impact of LI on FI. Our paper attempts to fill this gap. Our presumption is that LI plays an important role in promoting financial inclusion through access to bank accounts or debit and credit cards. However, our paper extends the findings of Aurazo and Vega (2021) by analyzing in depth the relationship between FI and LI. In particular, we estimate average marginal effects of and of LI and its transitions (movements between informal and formal jobs) on FI entry and exit probabilities.

### 2.2 Transition probabilities

While many studies have analyzed the determinants of FI, they have failed to investigate its dynamics. These are the factors that affect a person's decision to enter the financial system or exit from it at various points in time. This is all the more surprising since this is the approach that has traditionally been adopted to analyze income poverty (Bettin et al., 2022; Schotte et al., 2018), energy poverty (Alem and Demeke, 2020; Drescher and Janzen, 2021), and unemployment (Sarkar et al., 2019). These approaches have yielded results that provide guidance to policymakers to determine social welfare enhancing measures.

There is indeed a vast literature on the dynamics of poverty and unemployment that examines households' and individuals' transitions. This literature spans several years or even decades. For FI, which is a relatively recent topic in academic and policy circles, the available data are much more limited. Despite this constraint, the importance of FI to EMDEs means there is great value in exploring its dynamics. One way of doing this is to examine what information the available data convey on FI transition probabilities, ie the probabilities that a household/an individual enters and exits from the financial system. This is one of our research purposes and, in that respect, this paper should be viewed as an invitation to launch a literature on FI dynamics that could inform government and central bank policies.

The literature on the estimation of (poverty and unemployment) transition probabilities can be classified into two strands according to the class of models used (Capellari and Jenkins, 2008). A first approach consists of estimating discrete dependent variables such as entry and exit probabilities, with Probit or Logit models. However, as is well known, these studies may face a sample selection bias. On the one hand, the sample considered in the entry regression includes individuals who were in at a given period and out in the previous period. On the other hand, the exit decisions

at a given period are observed only for individuals who were previously in. Thus, the initial value of the dependent variable is potentially endogenous (Heckman, 1981). To overcome this problem, switching regression model estimators are sometimes used (Capellari and Jenkins, 2004; Jeon, 2008; Sarkar et al., 2019). These are similar to Heckman's two-step estimator.[8]

A second approach consists of using lagged dependent variable models, such as dynamic random effects probit models with unobserved heterogeneity and state dependence. This is the approach used by Drescher and Janzen (2021) who provide evidence of genuine state dependence effects in energy poverty in data on German households. They find that households are more likely to face energy poverty at a given period if they were energy-poor in the previous period. Likewise, Alem and Demeke (2020) find evidence of state dependence in energy poverty in Ethiopian data using a similar approach. More recently, Bettin et al. (2022) use Italian data to analyze the impact of FI on the dynamics of poverty, ie on the transition probabilities into and out of poverty. They use a dynamic random effects panel probit model and find that past poverty robustly affects current poverty.

Our paper is mostly related to this second stream of the empirical literature. We are interested in exploring whether FI should be treated as an auto-regressive process, reflecting the fact that there exists genuine state dependence, ie that the FI status in the previous period can determine the current period. To the best of our knowledge, this paper is the first attempt to analyze FI as a dynamic process. Our findings may be useful for policymakers to recognise that it is not only important for people to have an account and/or a debit or credit card, but also for the unbanked to remain banked over time.

# 3 Data and descriptive evidence

This section describes the data used and discusses some evidence on the dynamics of FI and transition probabilities. This helps to frame the question that we will more thoroughly address in the next sections.

## 3.1 The Encuesta Nacional de Hogares

The data we analyze is extracted from the *Encuesta Nacional de Hogares* (ENAHO), which is a Peruvian nationally representative household survey. The survey is conducted quarterly and aggregated yearly. We use yearly data from 2015 to 2018. Each of these surveys contains an employment module that collects answers of individuals to questions on their socio-demographic attributes and, since 2015, on FI and payments. In particular, ENAHO asks about access to accounts and payment instruments (debit and credit cards) provided by financial entities.[9] Using the answers to these questions, we create our main variable of interest, FI understood as the access to either an account, a debit card or credit card. In addition, individuals provide information on their labor informality status. A person saying that she/he has an informal employment means that

[8] This approach entails estimating the probability of being in the initial condition and calculating the inverse Mills ratio. This is then included as a correcting factor in the estimation of the entry and exit probability models (Sarkar et al., 2019).

[9] While this employment module of the surveys is conducted on people over 14 years of age, because of Peruvian law, questions on FI and payments are answered only by adults over 18 years old. ENAHO also contains information on how people pay (cash, debit or credit card, internet/mobile banking) their purchases of nine different categories of products (groceries, ready-to-eat food, laundry, utilities, cooking fuel, personal hygiene, clothing and footwear, furniture, and household appliances).

this person, who may work either for a formal or informal firm, does not enjoy all the social benefits of a job (eg does not have paid vacations or social security).

The overall ENAHO databases of 2015 through 2018 contain more than 300,000 observations. Of these, we keep only those individuals who were asked questions at least two consecutive years. We end up with a database of 102,578 observations to analyze the dynamics of FI, ie its one-year movements.[10]

We merge this employment module data with data from two other ENAHO modules containing various indicators at the household level, such as spending, area of residence (urban or rural), house infrastructure features (access to internet, electricity, mobile phone) and whether the household is a beneficiary of any social program (*JUNTOS*, *BECA 18* and *PENSION 65*). We also merge the database with data from Peru's banking supervisory agency containing information on the number of bank branches, ATMs, and bank agents at the district level from 2015 to 2018. To create quintiles of per capita household spending and financial network density, we use household and district databases and then generate the quintiles by year.[11] Table 1 shows the descriptive statistics of our variables in the database.

Table 1: Descriptive statistics

| Variable | Description | Obs. | Mean | Std. Dev |
|---|---|---|---|---|
| Financial inclusion | Yes=1, No=0 | 100,663 | 0.364 | 0.48 |
| labor informality | Informal=1, Formal=0 | 76,375 | 0.767 | 0.42 |
| Individual characteristics | | | | |
| Age | 18-24 years=1, 25-40=2, 41-64=3 , 65+=4 | 102,578 | 2.714 | 1.04 |
| Education | Elementary=1, High-school=2, Univ=3 , No univ=4 | 102,516 | 2.059 | 1.06 |
| Gender | Man=0, Woman=1 | 102,578 | 0.526 | 0.50 |
| Civil status | Married=1, Other=0 | 102,578 | 0.346 | 0.48 |
| Household characteristics | | | | |
| Residence area | Rural=1, Urban=0 | 102,578 | 0.313 | 0.46 |
| Receive social program | Yes=1, No=0 | 81,254 | 0.267 | 0.44 |
| Access to internet | Yes=1, No=0 | 94,470 | 0.253 | 0.43 |
| Access to mobile phone | Yes=1, No=0 | 94,470 | 0.903 | 0.30 |
| Access to electricity | Yes=1, No=0 | 94,470 | 0,929 | 0.26 |
| Per capita spending (PCS) | Total daily spending per household member | 100,762 | 20.27 | 16.13 |
| Quintile of spending | Quintile=1 (lowest),..., Quintile 5 (highest) | 94,470 | 2.715 | 1.38 |
| District characteristics | | | | |
| Total access points | Sum of bank branches, ATM and bank agents | 88,404 | 606.96 | 929.79 |
| Financial network density (FND) | Total access point per km square | 88,404 | 13.90 | 45.49 |
| Quintile of FND | Quintile=1 (lowest),..., Quintile 5 (highest) | 88,404 | 4.02 | 1.35 |

## 3.2 Descriptive evidence

An examination of our database suggests that FI has risen in Peru, but rather slowly, as gauged by the number of individuals possessing at least one financial instrument among a bank account, a debit card and a credit card. In 2015, 7.2 million people over 18 years of age, representing 35% of the working-age population, had at least one account or payment card. In 2018 these figures increased to 8.7 million and 40% respectively. Across the Peruvian regions, the development of FI is concentrated among southern coastal regions. Close to 1/3 of the regions increased their level of FI between 2015 and 2018 although the increment is moderate.[12] See figure 1.

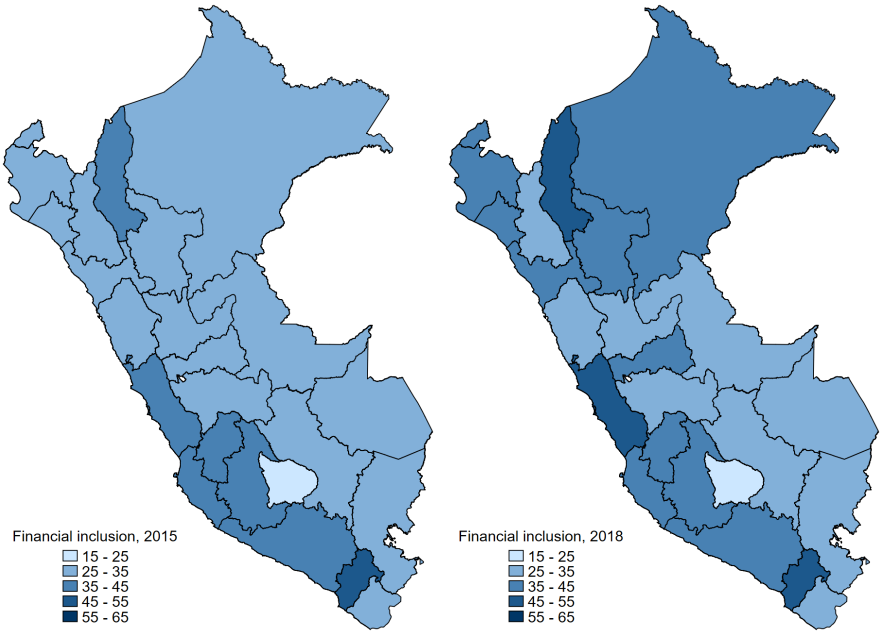
As indicated, Peru is one of the economies with the highest level of LI in the world, with three-quarters of workers being informal. Moreover, Figure 2 shows that three-quarters of workers with an informal job are unbanked. This contrasts with less than one-fifth of workers with a formal

[10] All the ENAHO databases can be downloaded freely (in Spanish) from `http://iinei.inei.gob.pe/microdatos/`.

[11] Thus, the quintiles differ not only among households and districts, but also over time.

[12] Peru is organized in 195 provinces grouped into 25 regions, except for Lima Province which does not belong to any region. According to official reports, FI should have increased significantly in 2021 due to the pandemic crisis during which the Peruvian government facilitated account opening in the state-owned bank Banco de la Nacion.

Figure 1: Access to bank accounts/payment cards in Peru: 2015 vs. 2018, % of adult population




(a) 2015 (b) 2018

Source: ENAHO 2015, 2018

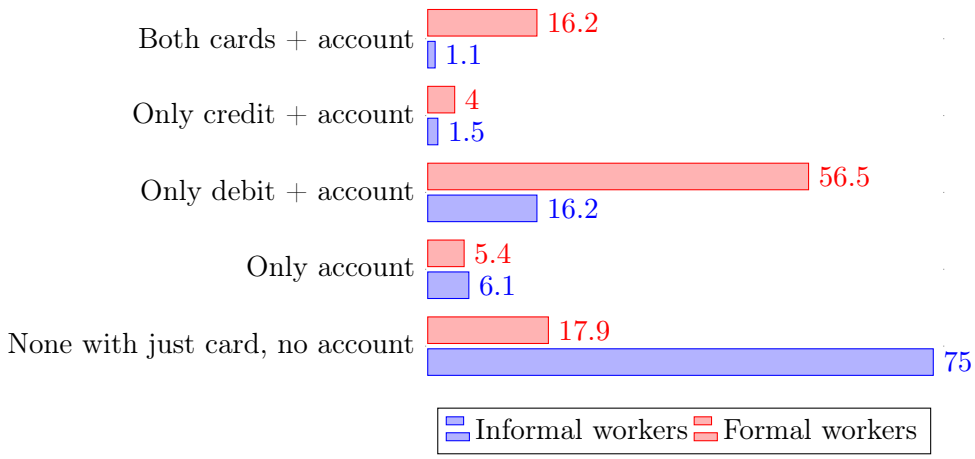
*Note:* Calculation using population expansion factor. The region with the lowest level (coloured in light blue) is Apurimac, located in the Peruvian highlands.

job. This might partially be explained by the fact that formal employers, ie those registered with the administration, are mandated by law to disburse their employees' salaries to bank accounts. Informal employers that bypass the legal burden of registration do not face this legal constraint and pay their employees in cash. In practice, even some formal employers do this, too.

Diving into payment instruments (see figure 2), we find that almost 4% of informal workers who are financially included have both debit cards and credit cards. Meanwhile, 1 out of 5 formal workers who are financially included has both a credit card and a debit card. This might be a consequence of the fact that financial institutions often ask for proof of stable income before providing credit lines and credit cards to people. This suggests that LI constrains not only access to accounts, but also to other financial payment products such as credit cards (and likely loans, insurances and other services). In addition, informal workers are less banked due to the fact that they have to incur some costs to open an account and to cash-in (travel time to go to a bank branch or an ATM). In the case of formal workers the bulk of these costs is generally borne by employers.

We now examine FI from a dynamic perspective and explore the process of entry to and exit from the financial system. Entry refers to a situation where an individual who was not financially included in period $t-1$, ie had no account, debit card or credit card, becomes financially included in period $t$, ie has at least one of these payment instruments. Exit occurs when an individual who was banked in period $t-1$ moves out of the financial system in period $t$. Table 2 panel (a) below gives the entry and exit rates in the data that proxy the probabilities of moving in and out of FI unconditional on LI. We see that on average, 15.3% of unbanked people move into the financial system in the next year (entry rate) while 21.9% of banked people move out of the financial system (exit rate).

Figure 2: Ownership of payment instruments, by type of job




Source: Panel ENAHO 2015-2018
*Note:* Sample calculations.

Table 2 panel (b) and (c) give the transition probabilities of FI conditional on LI status. We see that the entry rate to the financial system for formal workers is 49.6%, ie almost half of formal workers who were unbanked in the previous year move into the financial system the next year. Meanwhile, 6.5% of formal workers who were financially included in the previous year exit the financial system. The opposite occurs for informal workers, with only 12.4% of the unbanked moving into the financial system, while the exit rate is 33.9%. This means that a third of informal workers who were banked decide to move out of the financial system, ie to close their bank account, or cancel their debit or credit card.[13]

One can also consider transitions in the labor market. In particular, a person can move from informal to formal jobs, vice versa, remain in the informal sector or remain in the formal sector.[14] [15] Figure 3 gives the corresponding FI transitions conditional on labor market transitions. For those who remain in the informal sector in consecutive periods, the entry rate to the financial system is 11.5%, while the exit rate is 34%. The entry rate is much greater for those who remain in formal jobs (40.3%) or move into formal employments (53.9%). By contrast, the exit rate for these two categories are smaller (5.6% and 12.5%, respectively). Finally, for those who move out of a formal job, the entry rate to the financial system is 21% while the exit rate is 37.3%. Overall, we confirm that the entry rate to (formal) financial services is higher and the exit rate is smaller for those who remain in formal jobs or move into formality.

[13] By law, financial institutions in Peru are not allowed to close a bank account even if it has no transactions.

[14] A person can also stop or start working between periods, however this paper focuses on the movement in and out formality of active workers, ie a person who is always working.

[15] For example, the reader may consider the case of a taxi driver who has no social benefits and receives his salary (taxi fare) in cash (ie he is unbanked). Next year, he starts working as a driver for a formal employer, so he starts receiving a salary in a bank account (ie he is now banked). The opposite situation can also occur, eg if bank charges are high.

Table 2: Financial inclusion transition probabilities

| | | Period $t$ | | # Obs |
|---|---|---|---|---|
| | | Financially excluded | Financially included | |
| Period $t-1$ | Financially excluded | 84.7% (persistence rate) | 15.3% (entry rate) | 39,560 |
| | Financially included | 21.9% (exit rate) | 78.1% | 21,694 |
| # Obs | | 38,285 | 22,969 | 61,254 |

(a) Overall

| | | Period $t$ | | # Obs |
|---|---|---|---|---|
| | | Financially excluded | Financially included | |
| Period $t-1$ | Financially excluded | 50.4% (persistence rate) | 49.6% (entry rate) | 2,769 |
| | Financially included | 6.5% (exit rate) | 93.5% | 8,117 |
| # Obs | | 1,925 | 8,961 | 10,886 |

(b) Formal workers

| | | Period $t$ | | # Obs |
|---|---|---|---|---|
| | | Financially excluded | Financially included | |
| Period $t-1$ | Financially excluded | 87.6% (persistence rate) | 12.4% (entry rate) | 26,652 |
| | Financially included | 33.9% (exit rate) | 66.1% | 8,772 |
| # Obs | | 26,325 | 9,099 | 35,424 |

(c) Informal workers

Source: Panel ENAHO 2015-2018
*Note:* Sample calculations.

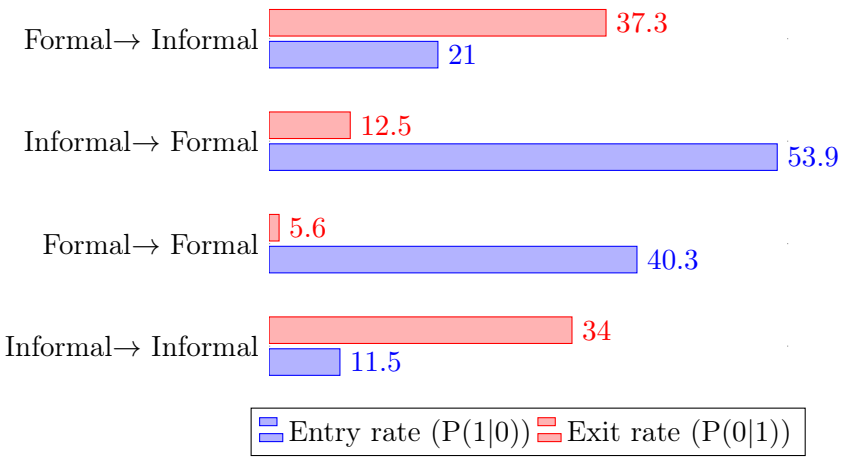
# 4 Econometric strategy

We now seek to assess such transitions more formally. Our analyzes will exploit the dynamic nature of the data. In particular, we use a first-order Markov process, ie test whether the past status of FI matters for its current status. Since the ENAHO surveys compile answers of a panel of individuals, we will use "short T with large N" dynamic panel data techniques of the type described in Hsiao (2010) and Pesaran (2015). This approach will also help us tackle the problem of endogeneity bias by modeling the transitions in and out of the financial and formal labor systems. Hence, we also study how LI and transitions in the labor market, ie movements between informal and formal jobs, affect the probabilities of entry to and exit from the financial system.

## 4.1 Labor informality and movements in and out of financial inclusion

Our analysis of FI from a dynamic perspective allows us to test two hypotheses. The first is whether there exists a genuine state dependence of FI, ie whether it should be treated as a dynamic process, like poverty and unemployment, rather than a static one. The second hypothesis we seek to test is

Figure 3: Financial inclusion transition probabilities by labor market transitions




Source: Panel ENAHO 2015-2018
*Note:* Sample calculations.

whether there exists a link between FI and LI, and in the affirmative to measure it.[16] The latter hypothesis entails determining how having an informal job can affect the probabilities of entry to and exit from the financial system.

In order to estimate movements into and out of FI, we follow the literature on transition probabilities in income poverty (Bettin et al., 2022), energy poverty (Alem and Demeke, 2020; Drescher and Janzen, 2021), and unemployment (Biewen, 2009) and use a first-order Markov model of the form:

$$y_{i,t} = \mathbb{1}(\psi y_{i,t-1} + \gamma L_{i,t-1} + \eta y_{i,t-1} \times L_{i,t-1} + x'_{it}\beta + c_i + \varepsilon_{i,t} > 0) \tag{1}$$

where $y_{i,t}$ and $y_{i,t-1}$ indicate the FI status at respectively period $t$ and period $t-1$. To study how LI affects FI transitions, we include a binary variable $L_{i,t-1}$ equal to 1 if individual $i$ in period $t-1$ has an informal job and 0 otherwise. We also include its interaction with the lag of FI. The vector variable $x$ allows us to control for individual characteristics such as education, age, gender, civil status (married or not), household characteristics such as urban vs. rural localization and per capita spending, and district characteristics relevant to FI such as the density of access points. Finally, $c_i$ reflects the individual permanent unobserved heterogeneity and $\varepsilon_{i,t}$ is an error term.

There are two difficulties we have to overcome in order to have unbiased estimators. First, there exists endogeneity because of simultaneity between FI and LI. To circumvent this issue, we include the lagged value of LI instead of its current one.[17] The second difficulty relates to the individual unobserved heterogeneity term $c_i$ and its correlation with the lag of the FI variable, ie the so called "initial conditions problem" due to the fact that the initial observations do not necessarily correspond to the beginning of the stochastic process. To overcome this problem, we apply the Wooldridge Conditional Maximum Likelihood (WCML) estimator (Wooldridge, 2005) by modelling

[16] A key difference between static and dynamic approaches in the context of this paper is the analyzes they enable. With a static probit model, we can only estimate the average marginal effects of LI on FI. With dynamic random-effects panel probit models we focus on the average marginal effects of LI on the probabilities of entry to and exit from the financial system.

[17] This might help take care of any potential endogeneity of LI which may stem from reverse causality and feedback effects from FI to LI and from common omitted variables affecting both FI and LI.

the distribution of the unobserved heterogeneity conditional on the initial dependent variable (FI) and explanatory variables (LI). We assume that:

$$c_i|(y_{i,0}, L_{i,0}) \sim \delta_1 y_{i,0} + \delta_2 L_{i,0} + \alpha_i \tag{2}$$

where $y_{i,0}$ and $L_{i,0}$ specify the initial conditions for respectively FI and LI, $\alpha_i \sim N(0, \sigma_\alpha^2)$ and is uncorrelated with the initial conditions variables $y_{i,0}$ and $L_{i,0}$.

Equation 1 can thus be rewritten as:

$$y_{i,t} = \mathbb{1}(\psi y_{i,t-1} + \gamma L_{i,t-1} + \eta y_{i,t-1} \times L_{i,t-1} + x'_{it}\beta + \delta_1 y_{i,0} + \delta_2 L_{i,0} + \alpha_i + \varepsilon_{i,t} > 0) \tag{3}$$

and the transition probability for individual $i$ at time $t$ can be expressed as:

$$Pr(y_{it} = 1|\alpha_i, y_{i0}, L_{i0}) = \Phi[\psi y_{i,t-1} + \gamma L_{i,t-1} + \eta y_{i,t-1} \times L_{i,t-1} + x'_{it}\beta + \delta_1 y_{i,0} + \delta_2 L_{i,0} + \alpha_i] \tag{4}$$

where $\Phi$ is the cumulative distribution function of the normal distribution. Equation 4 allows us to write the likelihood function to be maximized to obtain the maximum likelihood estimators.[18]

The specification of the auto-regressive process for FI allows us to estimate the transition probabilities, ie the probabilities of FI in $t$ conditional on FI in $t-1$. We focus on the entry and exit probabilities. Entry of individual $i$ is measured by the probability that this individual becomes financially included in period $t$ given that she/he was not banked in period $t-1$:

$$entry_{i,t} = Pr(y_{i,t} = 1|y_{i,t-1} = 0) \tag{5}$$

Similarly, exit of individual $i$ is measured as the probability that she/he moves out of the financial system in period $t$ given that she/he was banked in period $t-1$:

$$exit_{i,t} = Pr(y_{i,t} = 0|y_{i,t-1} = 1) \tag{6}$$

To measure the impact of LI (relative to formality) on the entry and exit probabilities, we compute the partial effects as

$$\Delta entry_{i,t} = Pr(y_{i,t} = 1|y_{i,t-1} = 0, L_{i,t-1} = 1) - Pr(y_{i,t} = 1|y_{i,t-1} = 0, L_{i,t-1} = 0) \tag{7}$$

and

$$\Delta exit_{i,t} = Pr(y_{i,t} = 0|y_{i,t-1} = 1, L_{i,t-1} = 1) - Pr(y_{i,t} = 0|y_{i,t-1} = 1, L_{i,t-1} = 0) \tag{8}$$

### 4.2 Labor market transitions and movements in and out of financial inclusion

In addition, we are interested in the way labor market transitions, ie movements between informal and formal jobs affect the entry and exit probabilities into and out of the financial system. Our view is that understanding how people go from informal to formal jobs, vice versa or remain in informal or formal jobs should yield insights on the dynamic process of entry to and exit from the financial system. Our hypothesis is that transitions in the labor market have an impact on those in the financial system.

[18] The likelihood function for individual $i$ is thus given by:

$$L_i = \int \left\{ \prod_{t=2}^{T} \Phi[(\psi y_{i,t-1} + \gamma L_{i,t-1} + \eta y_{i,t-1} \times L_{i,t-1} + x'_{it}\beta + \delta_1 y_{i,0} + \delta_2 L_{i,0} + \alpha_i)(2y_{i,t} - 1)] \right\} \phi(a)da$$

where $\phi$ is the density of the normal distribution.

In the Peruvian context, as some people perceive no real benefit in opening an account, one may expect that moving from a formal job to an informal one should increase the probability of exiting the financial system. By contrast, moving from an informal job to a formal one is likely to increase the probability of entering the formal financial system. Moreover, people remaining in informal jobs are more likely to move out of the financial system as they may not perceive any benefits from having an account unless they have previously used digital payments.[19] The opposite occurs for people who remain in formal jobs as they are more likely to open an account, eg to receive wages, and less likely to close it.

For that purpose, we have considered the following model specification:

$$y_{i,t} = \mathbb{1}(\psi y_{i,t-1} + \gamma LT_{i,t-1} + \eta y_{i,t-1} \times LT_{i,t-1} + x'_{it}\beta + \alpha_i + \varepsilon_{i,t} > 0) \tag{9}$$

where $LT_{i,t-1}$ captures the transitions in the labor market. This takes values from 1 to 4, where 1 indicates that the respondent has an informal job in both periods $t-2$ and $t-1$, 2 that the respondent has formal jobs in these two periods, 3 that the respondent moves from an informal job in period $t-2$ to a formal job in period $t-1$, and 4 that the respondent moves from a formal job in period $t-2$ to an informal job in period $t-1$.

Note that our base category is that the respondent remains in informal jobs in both period $t-2$ and $t-1$. Note also that we use the movements between informality and formality in periods $t-2$ and $t-1$ to avoid any issue of endogeneity with labor market transitions in period $t$ since LI in period $t$ is endogenous as discussed above. The rest of the variables are the same as those used before, the individual unobserved heterogeneity is modeled as in equation 2, and initial conditions for FI and LI are used.[20] The partial effects of each transition in the labor market on the entry and exit probabilities of FI are similar to those given in equations 7 and 8, but now each of the estimates is relative to the base category of remaining with informal jobs in both periods.

# 5 Results

We now discuss the estimation results obtained using the dynamic models presented in the previous section. These models have widely been used to study entry, exit and persistence in the context of various social phenomena such as unemployment, income poverty, energy poverty, health, among others.[21] In our context, the main challenge that the use of these models makes us face is to account for unobserved heterogeneity that can make individuals permanently more or less prone to experience FI in any given period. We must also account for feedback effects from previous periods spent being banked on the observed determinants of current FI.

To explore these dynamic effects, we first test the existence of state dependence of FI, ie whether being financially included in period $t-1$ matters for being financial included in period $t$. A positive answer will allow us to validate our econometric strategy for analyzing how LI affects the probabilities of entry to and exit from the financial system. Table 3 reports the results obtained for our

[19] We ran several econometric specifications with the lagged variable of digital payments, ie whether the individual reports paying with a debit card, credit card or internet/mobile banking in at least one of the nine categories purchased. This includes specifications where digital payments are crossed with FI, LI and transitions in the labor market. However, the coefficient associated with this variable as well as the changes in entry and exit probabilities turned out not to be statistically significant. These results are available from the authors upon request.

[20] Note that, by construction, the initial condition for the transitions in the labor market is the same as that for LI.

[21] A static identification of the determinants of the decision of individuals to be financial included in a given time period provides an incomplete picture of FI, leaving out the important question of whether these individuals are persistently or only temporarily financially included.

econometric specification shown in equation 3 with (column (1)) and without (column (2)) interaction terms between the lags of LI and FI. In addition, as a robustness check, columns (3) and (4) show the results when we run specifications with only individual controls and with individual and household characteristics, respectively. For convenience, we report in the table only the estimated parameters for the key variables, the average marginal effects of LI on FI transition probabilities and statistics for permanent unobserved heterogeneity. The complete results for full and alternative specifications are given in Table A.1 in the Appendix.

First, our results show that there exists a statistically significant state dependence between FI and its lag under both specifications. As our dependent variable FI is equal to 1 whether the individual is banked and 0 otherwise, this result implies that being financially included is a persistent phenomenon, namely that being financially included in the previous year increases the likelihood of being financially included in the current year. This result suggests that FI, or equivalently financial exclusion, should be viewed as an auto-regressive and not a static phenomenon. This is just like energy or income poverty as highlighted in the literature. In addition, the estimated log of the variance of the permanent unobserved heterogeneity ($ln\sigma_{\alpha}^{2}$) reveals a significant role of the unobserved heterogeneity in predicting the probability of having an informal job and being financially included. These results are robust to alternative specifications as shown in columns (3) and (4).

Secondly, LI, ie the status of having an informal job in period $t-1$, has a negative and significant impact on the probability of being financially included in period $t$ under both specifications. This result is quite consistent with our previous discussion (and also with the static approach and existing literature).[22] It highlights a key role for formal employment in helping people to escape financial exclusion since formal workers are often obliged to open an account to receive their salaries. The opening procedures are typically done by their employers rather than by the employees themselves. By contrast, informal workers mostly receive their salaries in cash and the account opening procedure might be seen as a substantial cost. They are thus less likely to have an account, a debit card or a credit card. As before, this result is robust to alternative specifications as can be seen from columns (3) and (4) of table 3.

To measure the impact of LI on getting in and out of FI, we include an interaction term between the lags of these two variables as in Bettin et al. (2022). The coefficient associated with the interaction term turns out not to be statistically significant. However, single coefficients may not be informative about the sign and magnitude of the average partial effects of LI on the probability of being banked or on the entry to and exit from the financial system. The average partial effects are statistically significant on both the entry and exit rates, as shown at the bottom of table 3. Thus, on the average, having an informal job reduces the probability of entering the financial system by around 8pp, whereas it increases the probability of exiting from it by around 9.3 pp. This result suggests that labor formality has a sizeable effect, specifically on preventing people from exiting the financial system.

We now move forward and analyze how transitions in the labor market affect movements into and out of FI as specified in equation 9. The estimation results are presented in table 4. Again, we consider two model specifications, with (column (1)) and without (column (2)) interaction terms between the lags of FI and each labor market transition probability. In addition, as robustness checks, columns (3) and (4) exhibit the results when we run specifications with only individual

[22]We ran a probit model and found that having an informal job decreases the probability of being financially included by 30 pp relative to having a formal job.

Table 3: Dynamic random-effects panel probit estimates (with labor informality)

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| L.fin | 0.565*** | 0.593*** | 0.367*** | 0.570*** |
| | (0.059) | (0.082) | (0.066) | (0.078) |
| L.informal | -0.403*** | -0.382*** | -0.463*** | -0.362*** |
| | (0.063) | (0.076) | (0.060) | (0.074) |
| L.fin × L.informal | | -0.035 | 0.050 | -0.047 |
| | | (0.069) | (0.056) | (0.067) |
| $ln\ \sigma_\alpha^2$ | -0.227 | -0.227 | -0.060 | -0.102 |
| | (0.124) | (0.124) | (0.088) | (0.109) |
| Log-likelihood | -11152.58 | -11152.44 | -18101.23 | -12939.56 |
| # Obs | 27,177 | 27,177 | 43,759 | 31,595 |
| # groups | 17,742 | 17,742 | 26,399 | 20,448 |
| Individual controls | ✓ | ✓ | ✓ | ✓ |
| Household controls | ✓ | ✓ | | ✓ |
| District controls | ✓ | ✓ | | |
| Average marginal effects (Informal Vs Formal (base)) | | | | |
| Δ entry probability | | -0.080*** | -0.093*** | -0.073*** |
| | | (0.017) | (0.013) | (0.016) |
| Δ exit probability | | 0.093*** | 0.088*** | 0.088*** |
| | | (0.016) | (0.013) | (0.015) |

Robust standard errors in parentheses; *: $p < 0.10$, **: $p < 0.05$, ***: $p < 0.01$.
Note: The reduced number of observations is partially due to the drop of observations in 2015.

controls and with individual and household characteristics, respectively.

As before, our results strongly suggest that there exists a state dependence between current and lagged FI status. Except for the probability of moving from labor formality into informality, the coefficients associated with each labor market transition probability are positive and statistically significant. This means that when any of these probabilities increases in period $t-1$, the probability of having an account, a debit card or a credit card in period $t$ increases relative to the base category, ie remaining in informal jobs in both periods. Finally, the interaction terms are not significant. But again, recall that its single value and magnitude cannot be interpreted. The results for the full specification and robustness checks are given in table A.2 in the Appendix.

Table 4 reports the average partial effects of each labor market transitions (relative to being stuck in informal jobs) on the probability of entry to and exit from the financial system. Our results suggest that workers who remain with formal jobs see their probability of entry increase by 9 pp and their probability of exit decrease by 12 pp relative to those workers who get stuck in informal jobs. For those who move into labor formality, they are 9.7 pp more likely to enter the financial system and 7.1 pp less likely to exit from it relative to our base category. This means that when a worker moves to formality, they should open a bank account to receive wages even if bank charges are high or they prefer anonymity and tax evasion. Finally, moving into LI turns out not to have a significant impact on the entry and exit probabilities of FI relative to our base category. In sum, our results suggest that LI plays a crucial role both in preventing that a person enters the financial system and ensuring that this person moves out of the financial system.

Our results show that labor formality plays a crucial role in the expansion of financial inclusion over time. In that sense, fighting against labor informality should not only increase ownership of bank accounts and/or payment cards in a given period but also help to have a higher (smaller) portion of banked people remain in (exit from) the financial system. However, other public policies and private efforts might be necessary to enhance financial inclusion, including, measures geared to

Table 4: Dynamic random-effects panel probit estimates (with labor market transitions)

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| L.fin | 1.229*** | 1.231*** | 1.241*** | 1.257*** |
| | (0.041) | (0.046) | (0.035) | (0.043) |
| L.formal → formal | 0.378*** | 0.318** | 0.490*** | 0.314** |
| | (0.109) | (0.128) | (0.095) | (0.122) |
| L.informal → formal | 0.270*** | 0.344*** | 0.416*** | 0.366*** |
| | (0.075) | (0.116) | (0.086) | (0.110) |
| L.formal → informal | -0.021 | 0.039 | 0.284*** | 0.059 |
| | (0.123) | (0.145) | (0.108) | (0.138) |
| L.fin × L.formal → formal | | 0.085 | 0.115 | 0.111 |
| | | (0.105) | (0.081) | (0.100) |
| L.fin × L.informal → formal | | -0.115 | -0.220** | -0.175 |
| | | (0.145) | (0.110) | (0.137) |
| L.fin × L.formal → informal | | -0.122 | -0.286** | -0.131 |
| | | (0.157) | (0.121) | (0.151) |
| $ln\ \sigma_\alpha^2$ | -12.91 | -11.71 | -11.69 | -11.72 |
| | (31839) | (9604) | (6611) | (9582) |
| Log-likelihood | -3932.23 | -3931.11 | -6600.56 | -4504.65 |
| # Obs | 10,220 | 10,220 | 17,030 | 11,737 |
| # groups | 7,849 | 7,849 | 12,434 | 9,035 |
| Individual controls | ✓ | ✓ | ✓ | ✓ |
| Household controls | ✓ | ✓ | | ✓ |
| District controls | ✓ | ✓ | | |
| Average marginal effects | | | | |
| Δ entry probability (Base: Informal → Informal) | | | | |
| Formal → Formal | | 0.090** | 0.139*** | 0.088** |
| | | (0.038) | (0.030) | (0.036) |
| Informal → Formal | | 0.097*** | 0.116*** | 0.104*** |
| | | (0.035) | (0.026) | (0.033) |
| Formal → Informal | | 0.010 | 0.076** | 0.016 |
| | | (0.038) | (0.031) | (0.037) |
| Δ exit probability (Base: Informal → Informal) | | | | |
| Formal → Formal | | -0.120*** | -0.188*** | -0.126*** |
| | | (0.033) | (0.025) | (0.031) |
| Informal → Formal | | -0.071*** | -0.066*** | -0.059** |
| | | (0.027) | (0.023) | (0.026) |
| Formal → Informal | | 0.027 | 0.001 | 0.023 |
| | | (0.046) | (0.038) | (0.045) |

Robust standard errors in parentheses; *: $p < 0.10$, **: $p < 0.05$, ***: $p < 0.01$.
Note: The reduced number of observations is partially due to the drop of observations in 2015 and 2016.

reduce withdrawal and deposit fees, increase merchant acceptance, enhance trust in the financial institutions and develop products with features that meet consumer needs such as instantaneous, secure, user-friendly and convenient.

# 6 Conclusion

This paper provides empirical evidence of the dynamic relationship between financial inclusion (measured here as the access to bank accounts or payment cards) and labor informality. We use micro data from Peru, which is a developing economy characterised by a large shadow economy, persistent labor informality, and a low but rising level of access to financial system. To the best of our knowledge, and in contrast to some other phenomena such as income poverty, energy poverty and unemployment that have been analyzed as dynamic processes, financial inclusion has been treated only in a static framework in the empirical literature. Our paper is an attempt to fill this gap. We apply a dynamic random-effect probit panel to test how labor informality and movements into and out of it (transitions between labor formality and informality) affect the probabilities of entry to and exit from the formal financial system. Our results are robust to alternative specifications that contain only individual controls, and with individual and household characteristics.

We find empirical evidence of the existence of a genuine state dependence of financial inclusion. More specifically, we show that current financial inclusion is affected by past inclusion. Focusing on labor informality as a determinant of owning a bank account or payment card, we find that having an informal job reduces the probability of gaining access to the financial system by about 8.0 pp and increases the probability of becoming financially excluded (exit from the financial system) by 9.3 pp. Moreover, examining whether movements between informal and formal jobs affect the likelihood of having an account, a credit card or a debit card, we find that, relative to workers who stay in informal jobs, those with formal employments that keep them are 9 pp more likely to enter the formal financial system and 12 pp less likely to leave the financial system. Those who move from informal to formal jobs are 9.7 pp more likely to become financially included and 7.1 pp less likely to become financial excluded.

The results reported in this paper shed light on a facet of labor informality that has been traditionally viewed through its direct economic effect in EMDEs. We provide empirical evidence on a new, indirect channel. Indeed, fighting labor informality is found to increase financial inclusion (the ownership of bank accounts or payment cards) that fosters economic development, alleviates poverty, allows modern digital transformation of payment systems, increases the effectiveness of monetary policies, and promotes financial stability. These positive spillover effects of labor formality strongly militate for government policies geared to promote it in developing countries. The novel analysis of the dynamic relationship between labor informality and financial inclusion carried out in this paper has highlighted a positive impact of labor formality on bank instruments ownership and on the probabilities of entry to and exit from the financial system.

We are well aware that, for better accuracy of estimates, some changes are needed. For instance, our analysis needs to be extended to more than 4 years of survey data and include recent events such as the COVID-19 pandemic. Moreover, financial inclusion measures should include other dimensions, such as use, quality, and affordability and services rather than just the access to account and payment cards. Nonetheless, this paper should open a promising avenue for future research on the labor informality and financial inclusion transitions.

# Appendix

Table A.1: Dynamic random-effects panel probit estimates (with labor informality)

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| L.fin | 0.565*** | 0.593*** | 0,367*** | 0,570*** |
| | (0.059) | (0.082) | (0,066) | (0,078) |
| L.informal | -0.403*** | -0.382*** | -0,463*** | -0,362*** |
| | (0.063) | (0.076) | (0,060) | (0,074) |
| L.fin × L.informal | | -0.035 | 0,050 | -0,047 |
| | | (0,069) | (0,056) | (0,067) |
| High-school | 0,133*** | 0,133*** | 0,142*** | 0,119*** |
| | (0,037) | (0,037) | (0,028) | (0,035) |
| Non-university | 0,539*** | 0,538*** | 0,656*** | 0,526*** |
| | (0,054) | (0,054) | (0,041) | (0,052) |
| University | 0,729*** | 0,728*** | 0,939*** | 0,715*** |
| | (0,058) | (0,058) | (0,045) | (0,056) |
| Female | 0,164*** | 0,165*** | 0,154*** | 0,200*** |
| | (0,028) | (0,028) | (0,023) | (0,027) |
| 25-40 years | 0,189*** | 0,189*** | 0,205*** | 0,226*** |
| | (0,054) | (0,054) | (0,044) | (0,052) |
| 41-64 years | 0,063 | 0,063 | 0,147*** | 0,093* |
| | (0,055) | (0,055) | (0,045) | (0,054) |
| 65 years + | 0,036 | 0,037 | 0,209*** | 0,078 |
| | (0,058) | (0,058) | (0,048) | (0,057) |
| Married | 0,070** | 0,070** | 0,054** | 0,069** |
| | (0,030) | (0,030) | (0,025) | (0,029) |
| Rural area | 0,020 | 0,020 | | 0,033 |
| | (0,039) | (0,039) | | (0,035) |
| Social program | 0,758*** | 0,759*** | | 0,826*** |
| | (0,045) | (0,045) | | (0,042) |
| Internet | 0,186*** | 0,186*** | | 0,193*** |
| | (0,037) | (0,037) | | (0,036) |
| Mobile phone | -0,005 | -0,005 | | 0,021 |
| | (0,049) | (0,048) | | (0,044) |
| Electricity | 0,015 | 0,015 | | -0,016 |
| | (0,057) | (0,057) | | (0,050) |
| Quintile 2 of PCS | 0,200*** | 0,200*** | | 0,190*** |
| | (0,040) | (0,040) | | (0,037) |
| Quintile 3 of PCS | 0,365*** | 0,365*** | | 0,408*** |
| | (0,047) | (0,047) | | (0,044) |
| Quintile 4 of PCS | 0,667*** | 0,668*** | | 0,685*** |
| | (0,055) | (0,054) | | (0,052) |
| Quintile 5 of PCS | 0,920*** | 0,920*** | | 0,956*** |
| | (0,063) | (0,063) | | (0,061) |
| Quintile 2 of FND | 0.052 | 0.052 | | |
| | (0.056) | (0.056) | | |
| Quintile 3 of FND | 0.036 | 0.036 | | |
| | (0.056) | (0.056) | | |
| Quintile 4 of FND | 0.022 | 0.022 | | |
| | (0.052) | (0.052) | | |
| Quintile 5 of FND | -0.064 | -0.064 | | |
| | (0.051) | (0.051) | | |
| fin0 | 1,452*** | 1,452*** | 1,706*** | 1,535*** |
| | (0,096) | (0,096) | (0,079) | (0,092) |
| informal0 | -0,318*** | -0,316*** | -0,376*** | -0,336*** |
| | (0,069) | (0,069) | (0,057) | (0,067) |
| _cons | -1.648*** | -1,669*** | -1,128*** | -1,804*** |
| | (0,114) | (0,121) | (0,072) | (0,112) |
| lnsig2u | -0,227* | -0,227* | -0,060 | -0,102 |
| | (0,124) | (0,124) | (0,088) | (0,109) |
| Obs | 27,177 | 27,177 | 43,759 | 31,595 |

Standard errors in parentheses; *: $p < 0.10$, **: $p < 0.05$, ***: $p < 0.01$.
(*) PCS: Household per capita spending, FND: Financial network density.

Table A.2: Dynamic random-effects panel probit estimates (with labor market transitions)

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| L.fin | 1.229*** | 1,231*** | 1,241*** | 1,257*** |
| | | (0,046) | (0,035) | (0,043) |
| L.formal→formal | 0.378*** | 0.318** | 0,490*** | 0,314** |
| | (0,109) | (0,128) | (0,095) | (0,122) |
| L.informal→formal | 0.270*** | 0.344*** | 0,416*** | 0,366*** |
| | (0,075) | (0,116) | (0,086) | (0,110) |
| L.formal→informal | -0.021 | 0.039 | 0,284*** | 0,059 |
| | (0,123) | (0,145) | (0,108) | (0,138) |
| L.fin×L.formal→formal | | 0,085 | 0,115 | 0,111 |
| | | (0,105) | (0,081) | (0,100) |
| L.fin×L.informal→formal | | -0,115 | -0,220** | -0,175 |
| | | (0,145) | (0,110) | (0,137) |
| L.fin×L.formal→informal | | -0,122 | -0,286** | -0,131 |
| | | (0,157) | (0,121) | (0,151) |
| High-school | 0,097** | 0,096** | 0,047 | 0,080** |
| | (0,043) | (0,043) | (0,030) | (0,040) |
| Non-university | 0,374*** | 0,371*** | 0,375*** | 0,363*** |
| | (0,066) | (0,066) | (0,047) | (0,063) |
| University | 0,506*** | 0,505*** | 0,548*** | 0,506*** |
| | (0,071) | (0,071) | (0,051) | (0,068) |
| Female | 0,127*** | 0,127*** | 0,084*** | 0,135*** |
| | (0,033) | (0,034) | (0,025) | (0,032) |
| 25-40 years | -0,076 | -0,076 | -0,031 | -0,008 |
| | (0,072) | (0,072) | (0,057) | (0,068) |
| 41-64 years | -0,156** | -0,158** | -0,044 | -0,089 |
| | (0,074) | (0,074) | (0,058) | (0,070) |
| 65 years + | -0,130* | -0,131* | 0,024 | -0,043 |
| | (0,076) | (0,076) | (0,060) | (0,072) |
| Married | 0,026 | 0,025 | 0,027 | 0,014 |
| | (0,034) | (0,034) | (0,026) | (0,032) |
| Rural area | 0,082* | 0,082* | | 0,102*** |
| | (0,044) | (0,044) | | (0,039) |
| Social program | 0,585*** | 0,585*** | | 0,608*** |
| | (0,055) | (0,055) | | (0,052) |
| Internet | 0,104** | 0,105** | | 0,114** |
| | (0,047) | (0,047) | | (0,045) |
| Mobile phone | -0,073 | -0,074 | | -0,069 |
| | (0,059) | (0,059) | | (0,052) |
| Electricity | 0,062 | 0,062 | | 0,052 |
| | (0,067) | (0,067) | | (0,057) |
| Quintile 2 of PCS | 0,183*** | 0,183*** | | 0,177*** |
| | (0,050) | (0,050) | | (0,046) |
| Quintile 3 of PCS | 0,347*** | 0,347*** | | 0,367*** |
| | (0,061) | (0,061) | | (0,056) |
| Quintile 4 of PCS | 0,486*** | 0,487*** | | 0,470*** |
| | (0,069) | (0,070) | | (0,064) |
| Quintile 5 of PCS | 0,669*** | 0,670*** | | 0,659*** |
| | (0,078) | (0,079) | | (0,074) |
| Quintile 2 of FND | 0.095 | 0.095 | | |
| | (0.067) | (0.067) | | |
| Quintile 3 of FND | 0.078 | 0.079 | | |
| | (0.064) | (0.064) | | |
| Quintile 4 of FND | 0.071 | 0.072 | | |
| | (0.059) | (0.059) | | |
| Quintile 5 of FND | 0.010 | 0.010 | | |
| | (0.058) | (0.058) | | |
| fin0 | 0,815*** | 0,813*** | 0,851*** | 0,802*** |
| | (0,062) | (0,062) | (0,049) | (0,060) |
| informal0 | -0,146 | -0,143 | 0,047 | -0,127 |
| | (0,102) | (0,102) | (0,077) | (0,098) |
| _cons | - -1,691*** | -1,693*** | -1,450*** | -1,751*** |
| | (0,174) | (0,174) | (0,106) | (0,161) |
| lnsig2u | -12,907 | -11,705 | -11,693 | -11,715 |
| | (31839,534) | (9604,926) | (6611,337) | (9582,787) |
| Obs | 10,220 | 10,220 | 17,030 | 11,737 |

Standard errors in parentheses; *: $p < 0.10$, **: $p < 0.05$, ***: $p < 0.01$.
(*) PCS: Household per capita spending, FND: Financial network density.

## References


Abdul Karim, Z., Nizam, R., Law, S. H., and Hassan, M. K. (2022). Does financial inclusiveness affect economic growth? new evidence using a dynamic panel threshold regression. *Finance Research Letters*, 46:102364.

Aguilar, A., Frost, F., Guerra, R., Kamin, S., and Tombini, A. (2024). Digital payments, informality and economic growth. BIS Working Papers, No 1196, July.

Ahmad, A. H., Green, C. J., Jiang, F., and Murinde, V. (2023). Mobile money, ICT, financial inclusion and growth: How different is Africa? *Economic Modelling*, 121:106220.

Alem, Y. and Demeke, E. (2020). The persistence of energy poverty: A dynamic probit analysis. *Energy Economics*, 90(3):10479.

Alfageme, A. and Ramirez-Rondán, N. (2018). Acceso de los hogares a los servicios financieros en Perú. Investigación conjunta en: María José Roa García Diana Mejía (ed.), Decisiones financieras de los hogares e inclusión financiera: evidencia para América Latina y el Caribe, edition 1, volume 1, chapter 8, pages 257-289, Centro de Estudios Monetarios Latinoamericanos, CEMLA.

Allen, F., Demirgüç-Kunt, A., Klapper, L., and Martinez Peria, M. S. (2016). The foundations of financial inclusion: Understanding ownership and use of formal accounts. *Journal of Financial Intermediation*, 27:1–30.

Aurazo, J., Banka, H., Frost, J., Kosse, A., and Piveteau, T. (2024). Central bank digital currencies and fast payment systems: rivals or partners? mimeo.

Aurazo, J. and Vega, M. (2021). Why people use digital payments: Evidence from micro data in Peru. *Latin American Journal of Central Banking*, 2(4):100044.

Bachas, P., Gertler, P., Higgins, S., and Seira, E. (2021). How debit cards enable the poor to save more. *Journal of Finance*, LXXVI(4):1913–1957.

Barajas, A., Beck, T., Belaj, M., and Ben Naceur, S. (2020). Financial inclusion: What have we learned so far? What do we have to learn? IMF WP/20/157.

Bettin, G., Pigini, C., and Zazzaro, A. (2022). Lifting you up or dragging you down? The role of financial inclusion in poverty transitions among Italian households. *Review of Income and Wealth.*, In Press.

Biewen, M. (2009). Measuring state dependence in individual poverty histories when there is feedback to employment status and household composition. *Journal of Applied Econometrics*, 24(7):1095–1116.

Boakye-Adjei, N., Auer, R., Frost, J., Prenio, J., Banka, H., Faragallah, A., and Natarajan, H. (2022). CBDCs: a new tool in the financial inclusion toolkit? FSI Insights, April.

Capellari, L. and Jenkins, S. P. (2004). Modelling low income transitions. *Journal of Applied Econometrics*, 19(5):593–610.

Capellari, L. and Jenkins, S. P. (2008). The dynamics of social assistance receipt: Measurement and modelling issues with an application to Britain. DIW Berlin Discussion Paper 828.

Carbo, S., Gardener, E. P. M., and Molyneux, P. (2005). Financial exclusion. Number 978-0-230-50874-3 in *Palgrave Macmillan Studies in Banking and Financial Institutions*. Palgrave Macmillan.

Central Bank of Kenya (2022). National Payments Strategy 2022-2025.

Committee on Payment and Market Infrastructures and World Bank Group (2016). Payment aspects of financial inclusion. Bank for International Settlements, Basel.

Demirgüc-Kunt, A., Klapper, L., Singer, D., and Ansar, S. (2022). The Global Findex Database 2021: Financial inclusion, Digital Payments, and Resilence in the Age of COVID-19. Washington, DC: World Bank.

Dogan, E., Madaleno, M., and Taskin, D. (2021). Which households are more energy vulnerable? Energy poverty and financial inclusion in Turkey. *Energy Economics*, 99:105306.

Drescher, K. and Janzen, B. (2021). Determinants, persistence, and dynamics of energy poverty: An empirical assessment using German household survey data. *Energy Economics*, 102:105433.

Dupas, P., Karlan, D., Robinson, J., and Ubfal, D. (2018). Banking the unbanked? Evidence from three countries. *American Economic Journal: Applied Economics*, 10(2):257–297.

Feghali, K., Mora, N., and Nassif, P. (2021). Financial inclusion, bank market structure, and financial stability: International evidence. *The Quarterly Review of Economics and Finance*, 80:236–257.

Fungacova, Z. and Weil, L. (2015). Understanding financial inclusion in China. *China Economic Review*, 34:196–206.

Galí, J., López-Salido, J., and Vallés, J. (2004). Rule-of-thumb consumers and the design of interest rate rules. *Journal of Money, Credit and Banking*, 36(4):739–763.

Hannig, A. and Jansen, S. (2010). Financial inclusion and financial stability: Current policy issues. ADBI Working Paper 259. Asian Development Bank.

Hart, K. (1973). Informal Income Opportunities and Urban Employment in Ghana. *The Journal of Modern African Studies*, 11(1):61–89.

Hayashi, F. and Minhas, S. (2018). Who Are the Unbanked? Characteristics Beyond Income. Economic Review, Federal Reserve Bank of Kansas City, issue Q II, pages 55-70.

Heckman, J. (1981). The incidental parameters problem and the problem of initial conditions in estimating a discrete choice time-discrete data stocasthic process in C.F. Manski & D. McFadden (Eds.), *Structural Analysis of discrete data with econometric application*. MIT Press.

Hsiao, C. (2010). *Analysis of panels and limited dependent variable models*. Cambridge University Press.

Hu, Y., Liu, C., and Peng, J. (2021). Financial inclusion and agricultural total factor productivity growth in China. *Economic Modelling*, 96:68–82.

Jeon, S. H. (2008). The impact of life cycle events on women's labour force transitions: A panel analysis. *Economic Record*, 84(S1):S83–S98.

Kebede, J., Naranpanawa, A., and Selvanathan, S. (2023). Financial inclusion and income inequality nexus: A case of Africa. *Economic Analysis and Policy*, 77:539–557.

Koomson, I. and Danquah, M. (2021). Financial inclusion and energy poverty: Empirical evidence from Ghana. *Energy Economics*, 94:105085.

Kosse, A. and Mattei, I. (2023). Making headway - Results of the 2022 BIS survey on central bank digital currencies and crypto. BIS Papers, no 136.

Kumar, A. (2005). *Access to financial services in Brazil*. The International Bank for Reconstruction and Development / The World Bank.

Martinez, J. and Woodruff, C. (2009). Assessing changes in household access to financial services in Mexico: An analysis of the BANSEFI/SAGARPA panel survey 2004-2007. *Well-Being and Social Policy*, 5(1):75–111.

Medina, L. and Schneider, F. (2018). Shadow economies around the world: What did we learn over the last 20 years? IMF Working Paper WP/18/17.

Mehrotra, A. and Yetman, J. (2014). Financial inclusion and optimal monetary policy. BIS Working Papers, no 476. December.

Morales-Resendiz, R., Vega, M., Aurazo, J., and Rodríguez, A. (2021). Retail payments and financial inclusion in Latin America and the Caribbean: Identifying gaps and opportunities. *Journal of Financial Market Infrastructures*, 9(2):55–91.

Murcia, A. (2007). Determinantes del acceso al crédito de los hogares colombianos. Borradores de Economía No. 449. Banco de la República.

Nenova, T., Thioro, C., and Ahmad, A. (2009). *Bringing finance to Pakistan's poor: A study on access to finance for the underserved and small enterprises*. The World Bank.

Pesaran, H. (2015). *Time series and panel data econometrics*. Oxford University Press.

Prasad, E. (2014). Distributional effects of macroeconomic policy choices in emerging market economies. *IMF Economic Review*, 62:409–429.

Sarkar, S., Sahoo, S., and Klasen, S. (2019). Employment transitions of women in India: A panel analysis. *World Development*, 115:291–309.

Schotte, S., Zizzamia, R., and Leibbrandt, M. (2018). A poverty dynamics approach to social stratification: The South African case. *World Development*, 110:88–103.

Shahbaz, M., Li, J., Dong, X., and Dong, K. (2022). How financial inclusion affects the collaborative reduction of pollutant and carbon emissions: The case of China. *Energy Economics*, 107:105847.

Shy, O. (2020). Low-income consumers and payment choice. *Research in Economics*, 74(4):292–300.

Siddiki, J. and Bala-Keffi, L. R. (2024). Revisiting the relation between financial inclusion and economic growth: a global analysis using panel threshold regression. *Economic Modelling*, 135:106707.

Tram, T., Lai, T., and Nguyen, T. (2021). Constructing a composite financial inclusion index for developing economies. *The Quarterly Review of Economics and Finance.*, In Press.

Tuesta, D., Sorensen, G., Haring, A., and Cámara, N. (2015). Financial inclusion and its determinants: The case of Argentina. BBVA Bank Working Paper 1503.

Wang, R. and Luo, H. (2022). How does financial inclusion affect bank stability in emerging economies? *Emerging Markets Review*, 51-Part A:100876.

Wang, W., Ning, Z., Shu, Y., Riti, M.-K. J., and Riti, J. S. (2023). Ict interaction with trade, fdi and financial inclusion on inclusive growth in top african nations ranked by ict development. *Telecommunications Policy*, 47(4):102490.

Wooldridge, J. (2005). Simple solutions to the initial conditions problem in dynamic, nonlinear panel data models with unobserved heterogeneity. *Journal of Applied Econometrics*, 20(1):39–54.

Zins, A. and Weil, L. (2016). The determinants of financial inclusion in Africa. *Review of Development Finance*, 6:46–57.

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