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# Informal Work along the Business Cycle: Evidence from Argentina

Julien Albertini\*    Arthur Poirier<sup>†</sup>    Thepthida Sopraseuth<sup>‡§</sup>

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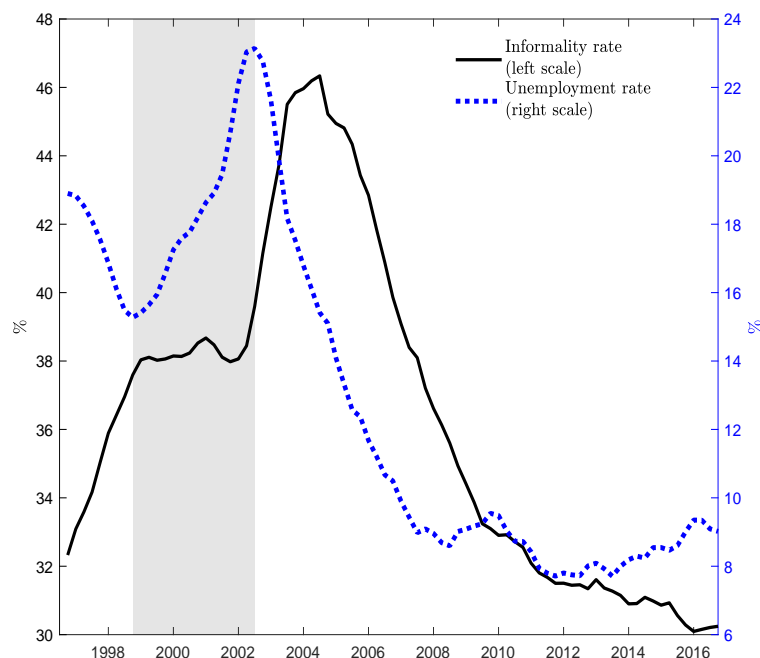
# 1 Introduction

Understanding how labor market inflows and outflows shape the unemployment fluctuations has led to a large body of research. While labor market fluctuations in OECD countries have been extensively documented (Petrongolo and Pissarides, 2008; Fujita and Ramey, 2009; Elsby et al., 2009; Shimer (2012), etc.), papers focusing on developing countries are scarce. An important aspect in emerging countries is the importance of the shadow economy. For instance, its share in GDP ranges from 25% to 60% in Central and South America (Schneider and Enste, 2000; OECD/CIAT/IDB, 2016). Furthermore, movements in the share of informal work are strongly cyclical. As shown by Figure 1 for the Argentine economy, the share of informal work increased by more than 12 percentage points between 1995 and 2005. After reaching historical highs of about 44%, it substantially declines. How much of the variations in unemployment are accounted for by movements in informal employment? Are workers in the informal sector more likely to find a formal job than non-employed individuals? Does the informal sector provides a buffer against income losses? In this paper, we identify the flows driving labor market dynamics in Argentina using a four-state approach (formal employment, informal employment, unemployment and non-participation). The large changes in Argentine informality provides a natural experiment to evaluate its contribution to unemployment fluctuations.

The modelling of informal labor markets has received a lot of attention in the recent years. In line with the flow approach of modeling the labor market, theoretical contributions based on two-sectors search and matching models have been developed (see for instance Boeri and Garibaldi (2006); Zenou (2008); Ulyssea (2010); Bosch and Esteban-Pretel (2012); Bosch and Esteban-Pretel (2015); Charlot et al. (2015), among others). These models are primarily used to understand the dynamics of labor market in economies with sizeable informal sector. The models are used as laboratories to experiment different labor market reforms such as introducing unemployment insurance, reducing taxes, modifying enforcement policies or changing the product and the labor market regulations. Despite the richness of the models, it is often difficult to compare them to the data given that time series of workers flows in emerging countries are severely lacking. Our work can serve as a useful tool for studying a broad variety of issues related to informality and business cycle fluctuations. The stylized facts and our variance decompositions provide an empirical background for the development of models embedding an informal sector.

To the best of our knowledge three papers are related to ours. Bosch and Maloney (2008) analyze the cyclical properties of worker flows in Brazil and Mexico using a five states

**Figure 1: Informality rate and unemployment rate**



Source: EPH. Argentina and authors' calculation. The shaded area corresponds to the period with positive growth of unemployment rate. Share of informal work is defined as number of workers employed in the informal sector divided by total employment.

approach<sup>1</sup>. They show that job separations of informal employment is the most important driver for the unemployment rate dynamic while movements in formal employment are largely accounted for by changes in the formal job finding probabilities from all other states. Souza and Zylberstajn (2016) investigate the ins and outs in Brazil in a four states approach similar to our. They find that introducing informal employment reduces the contribution of the employment exit rate to the changes in unemployment but raise the contribution of entries in the labor market.

While they document important stylized facts on worker flows in Latin America their methodology suffers from accuracy issues as it relies on a steady-state approximation for the unemployment rate. As documented by Elsbj et al. (2013) and Hairault et al. (2010) such method may be accurate in countries with large flows (like the US) where the steady state unemployment provides a good proxy for actual unemployment. In countries like Brazil, Mexico or Argentina, with a low turnover rate (low separation rate, low job finding rate for

<sup>1</sup>Formal employment, informal self-employment, informal salaried employment, unemployment, out-of-the labor force.

instance), the labor market dynamics evolves slowly, thereby producing sizeable deviations between steady state and actual unemployment. [Moreira et al. \(2018\)](#) compare the contribution of the flow rates in Brazil and the US. Consistent with [Elsby et al. \(2013\)](#) findings, they show that the use of the steady-state methodology lead to spurious approximations. The authors call for a methodology that accounts for unemployment changes out-of-the steady state. In this paper, we argue that such a claim is relevant in the case of Argentina too. Moreover, [Moreira et al. \(2018\)](#) do not assess the role of informal employment in explaining variations in unemployment. We focus on Argentina where the labor market evolves in a very different manner than that of Brazil. In particular, variations in the informal employment are several times larger, thereby offering an interesting environment to assess its contribution to unemployment. <sup>2</sup>

We conduct our analysis using the Argentine household survey (EPH) from 1995 to 2017. The data set poses two major challenges: (i) survey re-designed in 2003 and (ii) change in frequencies. Regarding (ii), Prior to 2003, the survey was conducted on a semi-annual frequency and it became quarterly after 2003. As for (i), the definition of unemployment changed in 2003 in order to meet ILO's standards. Before 2003, households were asked about their working activity during the last week of the six month survey. Thereafter, the reference period for their working activity has become the last four weeks.

In order to deal with the change in frequency, we use [Gomes \(2015\)](#) methodology. The idea is to adjust workers flows to reproduce changes in labor market stocks. His method nests on the assumption that the time-aggregation correction imposes within-period invariant transition rates. It follows that one can solve for the discrete time transition matrix at a particular frequency given that data have a different (usually lower) frequency. We then obtain quarterly labor market transitions observed at a semi-annual frequency (pre-2003 surveys) or observed at a quarterly frequency (post-2003 surveys). Using piecewise interpolation techniques, one can merge the two samples to get a unique continuous sample of quarterly transitions rates. One novelty of the present paper lies in the use of [Gomes \(2015\)](#) methodology to circumvent the discontinuity problem from the survey. By doing so, we provide quarterly time-series of quarter-to-quarter worker transitions for Argentina from 1996Q3 through 2017Q3. The data and the underlying stylized facts may serve as an empirical background to discipline theoretical models of informal work and to study long-run trends over the last 20 years as well as business cycle labor market responses.

Using variance decompositions and counterfactual exercises, we show that ins and outs of informal employment are key drivers of labor market fluctuations. In particular

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<sup>2</sup>In Appendix B, we present all our results using a steady-state approach and show that results are very different from the non-steady state approach used in our paper.

outflows from unemployment to informal employment solely account for by around 37% of the fluctuations in the unemployment rate. In addition, our analysis suggests that informality is: (i) a flexible sector that is used in recessionary periods as a buffer against income losses and (ii) a stepping stone towards formal employment. The surge in the informality rate between 1999 and 2005 is well explained by the increase in labor market entries with a pronounced effect for female workers as well as an increase in informal job finding probability. The former involves a particular form of *added-worker effect* as suggested by [Elsby et al. \(2015\)](#). A significant fraction of female workers enters the labor force to compensate households' income losses. Entry of female workers operate mainly into informal employment and to a lesser extent into unemployment. Consequently, we do find an *added-worker effect* but that mainly translates into flows from non-participation to informal employment directly.

From 2005 onwards, the decline in the informality rate is mainly explained by outflows towards formal employment and, to a lesser extent, towards non-participation. The variance decomposition by gender shows that the former is relevant for both, male and female workers, while the latter belongs essentially to female workers. One explanation is that the flexibility of informal employment makes job access easier even in recessions. However, as the economic conditions improve, informal workers either switch to formal jobs or exit the labor force. To further investigate the formalization issues we take advantage of the hiring credits policy launched during the Great Recession 2008. The policy consists in a reduction in the employer's social security contributions on all new hires by fifty percent the first year and by twenty five percent the second year. It also provides an amnesty of social security debt and sanctions for firms that formalize informal workers. While it is difficult to quantify the extent to which the decline in the informality rate is accounted for by the hiring credits policy, our counterfactuals suggest that it has had a positive impact on formalization.

The rest of the paper is organized as follows. We describe the data in [Section 2](#) and discuss our measure of worker flows in [Section 3](#). Variance decompositions as well as counterfactual exercises are presented in [Section 4](#). [Section 5](#) concludes.

## 2 Data

### 2.1 Data source

**The Argentina Permanent Household Survey.** We use survey data from the Argentinian Permanent Household Survey (Encuesta Permanente de Hogares, EPH), a nationally representative survey of the urban population (around 85% of total population). Between 1995 and 2003 the survey was conducted twice a year and switches on a quarterly basis

afterwards. The EPH collects information on employment status, hours and type of work, tenure of the current job, and demographics (gender, level of education, age, etc.). The EPH has a rolling unbalanced panel structure, which allows to follow workers across surveys (at semi-annual frequency before 2003, and at a quarterly frequency after 2003) and to compute transition rates across employment types.

**Definition of informality.** In order to distinguish informal workers from formal ones we take advantage of the information provided on social security contributions. Workers whose employer does not make social security contributions are classified as informal. This is in line with the standard definition of informality proposed by International Labour Organization and the literature (Leonardo and Tornaroli, 2009; Drenik, 2015). The sample includes all men and women between 16 to 64 years old that were classified as either employed, unemployed or out-of-the labor force. Within the group of employed individuals, all self-employed and business owners are dropped as EPH does not allow these individuals to be classified as formal or informal. Only individuals who work as salaried employees (whether formal or informal) are included in the sample.

**The 2003 survey re-design.** Our objective is to produce quarterly time series of labor stocks (employment, unemployment and non-participation) and worker flows over a long period (from 1996Q3 to 2017Q2). However, the 2003 survey re-design introduces a discontinuity in the data frequency. Until 2003 the EPH was conducted twice a year (once in May and once in October). Since 2003, the survey has been conducted on a quarterly basis. Regarding *labor stocks*, this discontinuity can be handled using an interpolation before 2003, so as to get quarterly time-series from semi-annual data. This is what we do in section 2.3 when we analyze the evolution of labor stocks. However, our study goes one-step further as we want to compute *worker transitions from one survey to the next*. Prior to 2003, the EPH then yields semi-annual worker transitions, versus quarterly transition after 2003. As a result, we then need to develop a specific correction to guarantee consistency over time of worker transitions. This is done in section 3.1.1.

## 2.2 Preliminary facts on informal work

In this section, we lay out several preliminary facts about informal workers. The average characteristics over the sample period are presented in Table 1. Over the sample period, informality is pervasive : 36% of Argentine employees are in informal employment. 59% of formal worker are male, versus 51% in informal employment. Women are more likely to have informal jobs than men. In addition, 9% of informal workers are aged 16-24 years, versus



27% in informal jobs. The incidence of informality is higher among low-skilled workers than it is among high-skilled ones. This result is consistent with [Albertini and Terriau \(2018\)](#) who use the schooling degree as a proxy for skill and [Porta and Shleifer \(2014\)](#) who document the productivity gap between formal and informal firms. It also suggests that informal jobs may often be the only opportunity available to unskilled workers. Table suggests [1](#) that, with respect to formal workers, workers in informal jobs are more likely to be female, young, low-skill and single. People associated with a weaker labor market position are more likely to work informally than others. This is consistent with the literature ([Günther and Launov, 2012](#); [Albertini and Terriau, 2018](#)) and the view that salaried informal jobs can be a subsistence strategy for workers who lack opportunities in the formal sector. Finally, informal employees are also more likely to work less (40 hours a week in formal work versus 36 hours in formal work) for a lower hourly wage (10.6 pesos per hour) than their counterparts in formal employment (17.4 pesos per hour).

**Table 1:** Socio-demographic characteristics of employment

	Formal	Informal
<b>Gender</b>		
Male	58.57(a)	50.85
Female	41.43	49.15
<b>Age</b>		
16 to 24 years	9.14	27.33
25 to 54 years	80.15	64.58
55 to 64 years	10.70	8.08
<b>Education</b>		
Primary-school and less	17.83	35.70(b)
<b>Marital status</b>		
Married or common-law couples	66.70	48.48
Widowed; divorced; separated	7.90	8.65
Single	25.39	42.87
<b>Job</b>		
Weekly hours	40.6	36.2
Hourly wage	17.42	10.6(c)

(a) 58.57% of workers in formal employment are male

(b) 35.70% of workers in informal employment are low-educated (educational attainment is primary school and less)

(c) average hourly wage in informal employment. In order to compare wages across years, we regress wages of the main occupation on a time trend and squared time trend and consider the residuals. Such residuals capture wages after taking out possible time trends due to inflation and technological progress. We apply the same methodology to compute average hourly wage in the formal sector.

## 2.3 Labor Market Stocks: the great reversal of informality rate

Figure 2 depicts the evolution of the Argentine labor market stocks between 1996Q3 and 2017Q2. First, let us notice that non-participation remains rather stable from the beginning of the sample until 2002 while all other variables vary substantially. This might suggest that non-participation plays little role in accounting for unemployment changes. However, a given change in non-participation can actually be driven by large fluctuations in workers' transitions in opposite directions, thereby canceling out each other. This problem known as the 'stock-flow fallacy' (Elsby et al., 2015) arise when using a stocks-based analysis of the labor market. Our stock-flow framework will actually allow to shed light on the role of fluctuations transition from/to non-participation in driving unemployment dynamics.

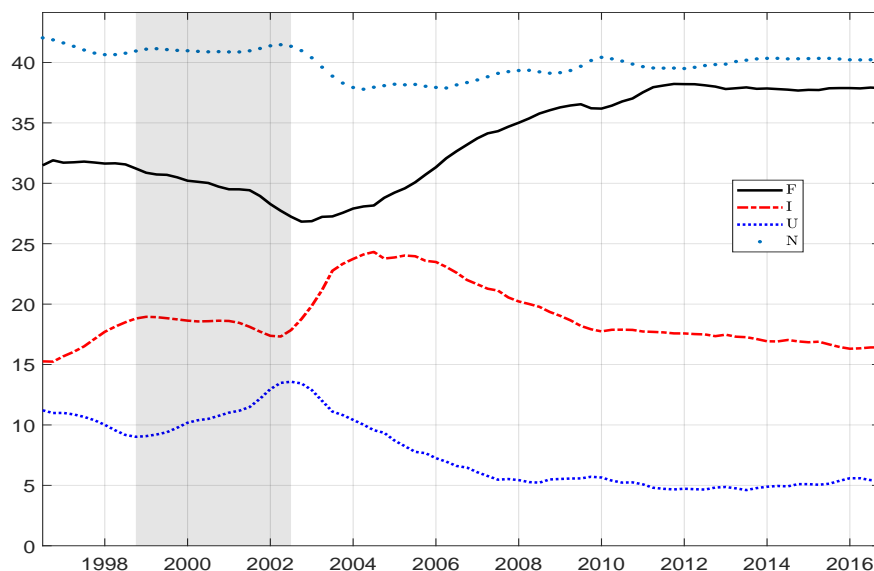
Second, at the trough of the recession, in 2002, 13.6% of the working age population was unemployed. The recessionary ramp up in the unemployment rate (1999Q2-2002Q1) was mainly driven by the joint fall in formal and informal employment, with a more sizeable effect on formal employment (from 31% to 26% of the working age population, versus 18.8% to 17% at its lowest point for informal work). Interestingly, the subsequent decline in unemployment unfolds in three stages. First, between 2002Q1 and 2003Q3, informal employment was on the rise while the fall in formal employment came to a halt. The fast recovery of the informal sector is consistent with Drenik (2015)'s findings according to which the larger drop in real wage of informal workers have fostered informal employment in the aftermath of the crisis. Then, in 2004, both employment stocks increased until 2005Q1. Finally, from 2005Q2 onwards, informal employment has been going down while formal employment has kept expanding. Since 2011, the Argentine labor stocks have remained fairly stable compared to the turbulent period associated to the 2001 economic crisis.

## 3 Measuring worker flows

### 3.1 Empirical strategy

The worker flows are obtained by exploiting the rotating-panel structure of the Argentine survey data. Individuals in a given survey are linked longitudinally to their response in the subsequent survey. This property allows to estimate worker flows and their associated transition probabilities. For example, the probability that an unemployed worker finds a formal job can be computed as the share of the unemployed in a given survey who report in the subsequent survey that they are in formal employment. We can then compute transition probabilities between employment in formal and informal jobs, unemployment and non-participation.

**Figure 2: Labor market in Argentina, 1996Q2-2017Q2**



*Source: Argentine Household Survey and authors' calculation. Stocks are expressed as a percentage of the working age population. Shaded area denotes periods with positive growth of unemployment rate.*

### 3.1.1 Discontinuity in Argentine data

**The 2003 survey re-design.** Until 2003, the EPH was conducted twice a year (once in May and once in October). Only 25% of the surveyed households were replaced across semesters, which implies that 75% of the sample could be followed over a 6 months period, 50% over a year and 25% over a year and a half. Since 2003, the survey has been conducted on a quarterly basis and the rotation scheme has been modified. Households are interviewed for two consecutive quarters, rotate out for two quarters and then rotate in for two additional quarters. The 2003 re-design introduces a daunting challenge for a researcher looking for quarterly transition rates over the whole period (1996Q3-2017Q3).

Drenik (2015) opts for transition rates on an annual basis. His methodology has the advantage of providing consistent measures of worker flows over time but involves two major limitations. First, he does not compute transition rates between 2002 and 2003, a crucial period marked by a spike in the informality rate and a decline in the unemployment rate. In order to cover this meaningful period, we use EPH supplementary data provided by the Argentine ministry of labor ("EPH Relevamiento Experimental, 2003"). It was developed to cover this particular transition period lying between the two survey designs. Second, as we are interested in labor market adjustment along the business cycle, we strive for labor

market transitions at a higher frequency, namely quarterly frequency in our paper, versus annual frequency in [Drenik \(2015\)](#).<sup>3</sup> In doing so, our approach is consistent with the standard practice in the literature and allow for international comparisons.

Using quarterly EPH, after 2003, we end up with quarterly transition probabilities available at a quarterly frequency. Using semi-annual EPH, before 2003, one would get semi-annual transition probabilities available at a semi-annual frequency. A major discontinuity arises. The main problem lies in the change in the time dimension of the worker flows. Indeed, for instance, we cannot compare the probability of job finding in the next 6-months (available prior to 2003) with the probability of job finding in the next quarter (computed only after 2003). To illustrate this point, let us consider for instance the job finding rate. After 2003, we are able to compute quarterly unemployment exit. When an unemployed worker faces a  $x\%$  probability of finding a job each quarter, the average duration of unemployment spell is  $\frac{1}{x}$ , which is expressed in *quarters*. Prior to 2003, we compute semi-annual job finding rate of  $y\%$  such that the average duration of unemployment spell is  $\frac{1}{y}$ , which is expressed in *6-month* units.

In order to solve this problem, we proceed in the following way. Quarterly worker transitions computed using surveys after 2003 are left unchanged. The correction applies to semi-annual worker flows computed using surveys prior to 2003. We then use [Gomes \(2015\)](#)'s methodology. [Gomes \(2015\)](#) notices that labor market transition rates can be estimated from surveys with various frequencies (whether monthly in US data or quarterly in French, UK or Spain). He proposes a methodology to make them comparable. While his work relates to international comparisons of labor market transition rates, we apply his suggestion to handle the discontinuity in Argentine data prior to 2003.

The methodology is described in [Appendix A.1](#). The intuition behind the correction is the following. We model worker flows as a Markovian process. We then solve a Markovian model of quarterly labor market transitions such that the dynamic system replicates the observed semi-annual worker flows. We use [Gomes \(2015\)](#)'s correction to get quarterly transitions from semi-annual transitions. We now have all transitions with the same time dimension, that is quarterly. We now have to deal with the discontinuity in the frequency of observations, that is semi-annual. In order to get worker flows observed at quarterly frequency before 2003, we use piecewise interpolation on semi-annual data. At the end of the process, we get quarterly transitions, observed at quarterly frequency, from 1996Q2 through 2017Q2.

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<sup>3</sup>In addition, [Drenik \(2015\)](#) does not perform the corrections described in [section 3.1.2](#) and [Appendix A](#). We discuss in [Appendix B](#) the impact of some corrections on the results.

### 3.1.2 Empirical strategy

In order to build worker flows we adopt a Markovian representation. The mapping between labor force stocks and flows is modeled as a simple discrete-time Markov chain:

$$X_t = \ell_t X_{t-1} \quad (1)$$

where  $X_t = (F_t, I_t, U_t, N_t)$  denote the 4 labor market stocks *i.e.* formal employment, informal employment, unemployment and non participation.  $\ell_t$  is a square matrix of size 4, whose elements  $\ell_{i,j}$  capture the transition probability from labor status  $i$  to labor status  $j$ .

We adjust the data along three dimensions as in [Elsby et al. \(2015\)](#). We first seasonally adjust gross flows using the X12 ARIMA process. We then compute transition probabilities that are consistent with the observed changes in stocks  $(F_t, I_t, U_t, N_t)$  (correction for margin error, see [Appendix A.2](#)). Finally, as gross flows provide transition probabilities observed at discrete points in time, we correct these measures for possible transitions occurring between consecutive surveys, ([Shimer, 2012](#), see [Appendix A.3](#)). We then get instantaneous transition rates (also referred to as hazard rates)  $\lambda_{ij}$ , derived from a continuous-time model of labor market transitions. Adjusted transition probabilities are then derived from instantaneous transition rates as  $1 - e^{-\lambda_{ij}}$ . Further details are provided in [Appendix A](#).

## 3.2 Long-run averages of transition probabilities

[Table 2](#) reports average transition probabilities between formal and informal employment, unemployment and non-participation. A first striking feature lies in a general comparison between the Argentine labor market and its US counterpart. The Argentine labor market is characterized by less turnover than in the US. For instance, Argentine unemployed workers face a total of 26.5% probability each quarter of finding a job, whether formal or informal, (which corresponds to an average duration on unemployment spell of 3.77 quarters, nearly a year), versus 40% monthly in the US (an average unemployment duration of 2.5 months, [Shimer, 2012](#)). In Argentina, the average job separation rate in the informal sector amounts to 7.24% each quarter and 1.45% in the formal sector. The average duration of job is then 3.5 years and 17 years in the informal and the formal sector respectively. To put these numbers into perspective, the monthly job separation rate in the US is around 3% and the average tenure duration is approximately 3 years. The lower turnover on the Argentine labor market calls for a methodology that accounts for changes in stocks out-of-the steady state to measure accurately worker flows and the variance decomposition of unemployment fluctuations (see [Section 4.1](#)).

Secondly, informal work appears as an unstable labor market status *i.e.* inflows and

outflows are several time larger than that of formal work. Each quarter, 7.24% of informal workers lose their job, 12% of them directly join the pool of non-participants. These outflows from informal work to non-employment (whether to unemployment or non-participation) are 5 to 7 times larger than outflows from formal work (1.45% and 1.77% respectively). Finally, informality seems to be an easier channel to access employment. Indeed, transition rates from unemployment to employment as a whole are largely explained by the transition rates from unemployment to informal employment. Specifically, the transition rate from unemployment to informal employment (21%) is much higher than that from unemployment to formal employment (5.5%), and from non-participation to informal work (5.97% per quarter, versus 1.32% to formal work).

**Table 2: Average quarterly transition probabilities**

State $t$	State $t + 1$	F	I	U	N
F		92.58	4.20	1.45	1.77
I		8.99	71.76	7.24	12.01
U		5.46	21.05	44.75	28.73
N		1.32	5.97	5.11	87.60

Source: Encuesta Permanente de Hogares 1996Q3-2017Q3 and authors' calculation

"F" Formal employment, "I" Informal employment,

"U" unemployment, "N" Non-participation. (a) each quarter,

7.24% of informal workers lose their job. (b) each quarter, 21.05%

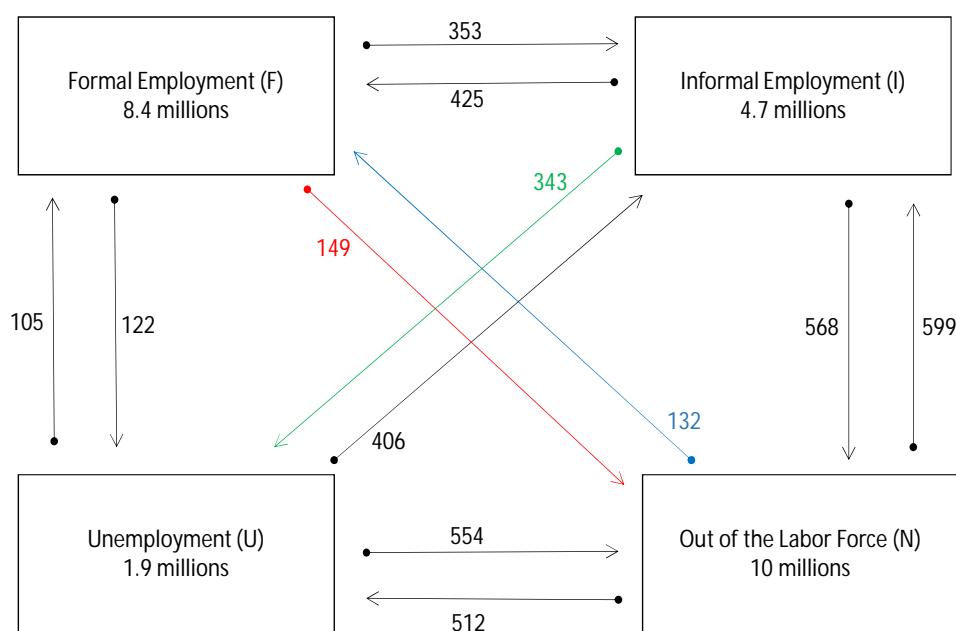
of unemployed workers find a job in the informal sector.

Is informal employment a stepping stone to formal employment? Each quarter, 8.99% of informal workers become formal workers the following quarter. While this rate involves a slow formalization process, it is still substantial when compared with the formal job finding probability from unemployment ( $UF$  at 5.46%) and non-participation ( $NF$  at 1.32%). Once the worker succeeds in getting a formal job, this labor market status appears very stable with a low quarterly separation rate of 1.45% to unemployment and 1.77% to non-participation. To that extent, we consider that informality introduces duality in the Argentine labor market, with fragile/unstable informal work and protected/stable formal work. This duality is reminiscent of the Spanish and French duality based on permanent versus temporary labor contract (Silva and Vázquez-Grenno, 2013; Cahuc et al., 2016).

Figure 3 summarizes the quarterly average worker flows between the four labor market

states. With respect to Table 2, Figure 3 indicates the volume of quarterly flows in thousands of individuals. Table 2 is not informative enough on the magnitude of the worker flows as transition probabilities in the Table apply to stocks of different sizes. In particular, as can be seen on Figure 2, the largest stocks are non-participation and formal employment. Over the whole period, Argentine working population amounts to 25 millions on average, with 8.4 millions in formal employment, 4.7 millions in informal employment, 1.9 unemployed workers and 10 millions out-of-the labor force. As a result, given the large size of the stock of non-participants, small numbers in the last row of Table 2 actually affect a large number of workers.

**Figure 3: Average worker flows, 1996-2017**



*Source : Argentine Household Survey, authors' calculation. Worker transitions expressed as total number of people in thousands. Example: each quarter, out of the 1.9 million unemployed workers, 105 000 find a formal job, 406 000 find an informal job, 554 000 leave the labor force.*

Flows involving informal work are large: each quarter, 343 000 informal workers become unemployed, 568 000 of them leave the labor force. Flows in the reverse direction are also sizeable: each quarter, 406 000 unemployed workers and 599 000 non-participants find an informal job. All inflows into informal employment involve 1 348 000 workers each quarter,

while outflows from informal employment amount to 1 336 000 workers. Inflows are as large as outflows, which illustrate the "stock-flow fallacy": a smooth evolution of stocks in Figure 2 actually hides large ins and outs. This illustrates why we need to look at worker flows to improve our understanding of Argentine labor market.

Figure 2 is suggestive of a labor market duality as in the Spanish labor market with temporary and permanent contract. However, the Argentine labor market is characterized by a distinctive feature. Labor market duality in the Spanish market has less impact on the relationship between employment and inactivity as the ins and outs of non participation mainly involve permanent contract. In contrast, in Argentina, the ins and outs of non participation to/from informality (involving 568 000 + 599 000 workers each quarter) are much larger than the ins and outs of non participation to/from formal work (involving 149 000 + 132 000 workers). This indicates that informality lies at the frontier of labor market attachment.

### 3.3 Evolution of worker flows

Figure 4 displays the evolution of transition rates over the business cycle. The transition rates appear very cyclical, which contrasts with the smooth evolution of stocks displayed on Figure 2. This contrast illustrates the relevance of "stock-flow" fallacy as smooth changes in stocks actually hides large fluctuations in underlying worker transitions.

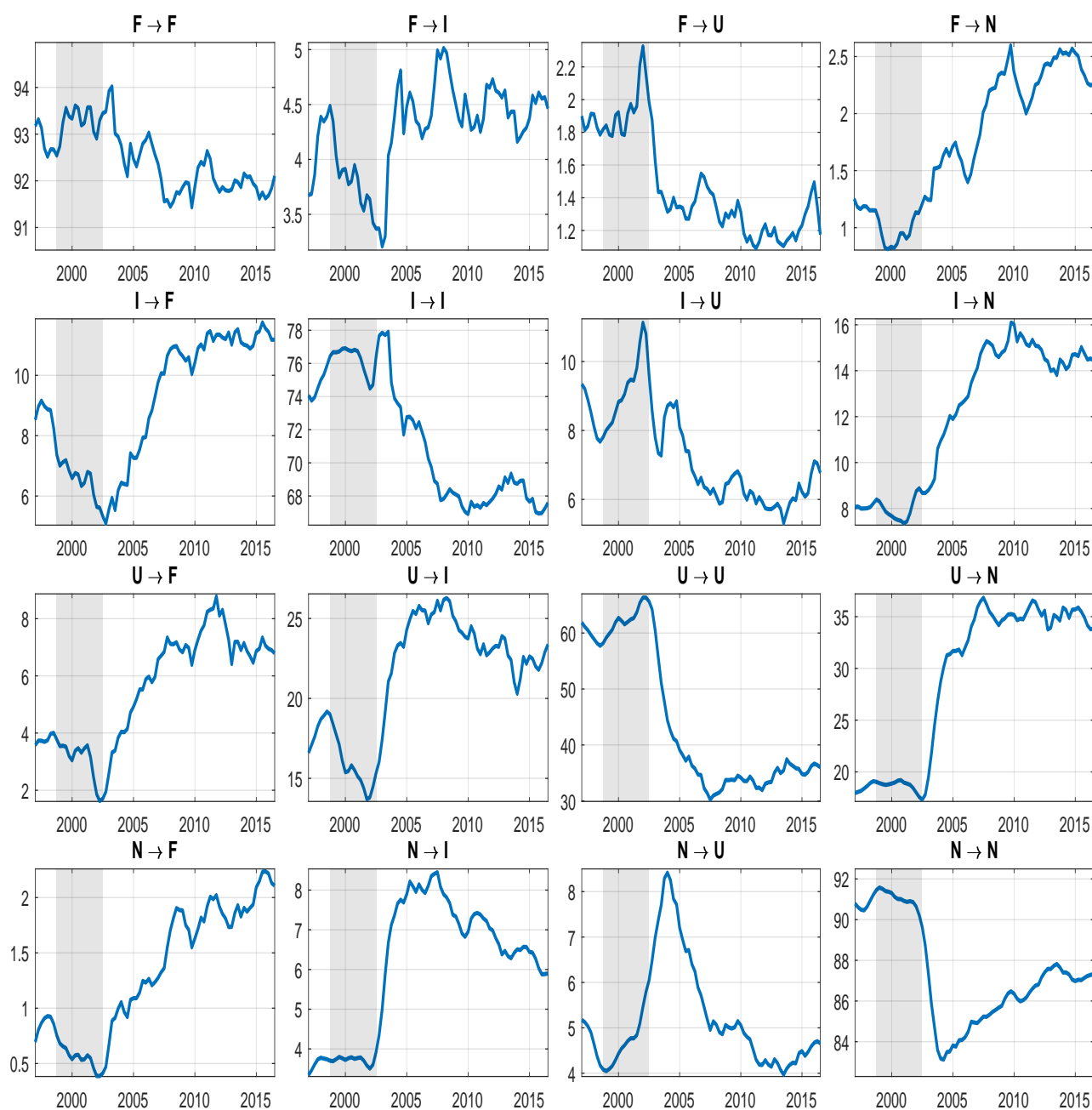
How different is the cyclical behavior of worker flows from that of OECD countries? We compare our results to [Elsby et al. \(2015\)](#) to highlight the difference between developed and developing countries. We focus on the most severe recession *i.e.* 1999Q2-2002Q1 and the period during which informality experienced a great reversal, that is 2005Q1-2008Q1.

As in other OECD countries, the probability of finding a formal job (UF and NF), is procyclical. The informal job finding rates (UI and NI) depict very similar patterns albeit the NI flows is almost constant at the beginning of the sample. Outflows from employment to unemployment behave similarly in the formal and informal sector. They increase sharply when the economy enters the recession and decline rapidly as the economy recovers. Outflows from employment to non-participation (FN and IN) remain barely unchanged during the recession like in the US case. However, the expansionary phase of the cycle is marked by a surge in labor force exits, which contrasts with the US experience. Job-to-job transitions reveal a significant increase in the access of formal jobs by informal workers.

Last but not least, [Elsby et al. \(2015\)](#) document two important stylized fact: *(i)* the non-participation to unemployment transition (NU) is countercyclical and *(ii)* the unemployment to non-participation (UN) transition is procyclical. The former seems valid in the



Figure 4: Transition probabilities



"F" Formal employment, "I" Informal employment, "U" unemployment, "N" non participation. Shaded area denotes period with positive growth of unemployment rate.

case of Argentina during the 2001 recession, albeit the major part of the increase in the NU flow came late in the crisis. The latter follows a very different path. It does not change during the recession and doubles during the expansion until 2005. These results suggest that fluctuations in the Argentina labor market are the outcomes of different adjustments than those in the US.

## 4 Understanding the ins and outs of Argentine informal work

### 4.1 Methodology

With estimates of the transition rates in hand, our goal is now to decompose cyclical fluctuations in unemployment rate into contributions attributable to each of the flow hazards. To do so, we adapt the dynamic decomposition of [Elsby et al. \(2015\)](#) to our empirical model. The main advantage of this method relies on the fact that it is not based on a steady-state approximation of labor market adjustments. Given the relatively low level of worker flows on the Argentine labor market, with respect to the US, a non-steady state decomposition becomes even more relevant. We obtain the following  $\beta$  statistic measuring the share of unemployment variance that is accounted for by the hazard rate from  $i$  to  $j$ :

$$\beta^{ij} = \frac{\text{Cov}(\Delta u_{t-1,t}, \Delta \tilde{u}_{t-1,t}^{ij})}{\text{Var}(\Delta u_{t-1,t})} \quad (2)$$

where,  $\Delta$  is the first difference operator and  $\tilde{u}_{t-1,t}^{ij}$  the counterfactual unemployment rate obtained when only one worker flows fluctuates.<sup>4</sup> In order to compute  $\tilde{u}_{t-1,t}^{ij}$ , we proceed as follows. First, we compute labor market stock changes that are driven by contemporaneous but also *past* changes in transition rates. This recursive formulation of stock variations is at the heart of the non-steady state decomposition. Second, we express the variance of any given labor market stock as the sum of its covariance with any counterfactual obtained in the previous step. Notice in Equation (2) that a covariance appears in the expression of  $\beta$  such that negative values of  $\beta$  can possibly appear.

As we are not interested in the decomposition of stock changes *per se* but rather the decomposition of the unemployment rate, we use a first-order Taylor expansion to approximate unemployment changes:

$$\Delta u_t = \frac{(1 - u_{t-1})\Delta U_t - u_{t-1}\Delta E_t}{L_t} \quad (3)$$

---

<sup>4</sup>This variance decomposition is reminiscent of the  $\beta$  variance decomposition used in CAPM.

with  $E_t$  being the total employment stock and  $L_t$  the labor force (the sum of  $U_t$  and  $E_t$ ). Notice that we should have  $\sum \beta^{ij} \approx 1$  where the difference from unity is accounted for by approximation errors. Similarly, changes in the informality rate are such that:

$$\Delta i_t = \frac{(1 - i_{t-1})\Delta I_t - i_{t-1}\Delta F_t}{E_t} \quad (4)$$

with  $i$  the informality rate and  $E_t$  the total employment stock (the sum of  $I_t$  informal employment and  $F_t$  formal employment).

## 4.2 Unemployment variance decomposition: Argentine labor market duality

Column (1) of Table 3 reports the shares of the variance of the unemployment rate accounted for by each hazard rate  $\lambda_{ij}$ . It is shown that pro-cyclical rates of job finding (unemployment outflows) account for a substantial fraction ( $\beta^{UF} + \beta^{UI} = 46\%$ ) of fluctuations in aggregate unemployment rate while job separation (unemployment inflows) accounts for 24% of unemployment changes. Ins and outs of non-participation also account for 24% of unemployment fluctuations. In this regards, the Argentine economy share similar pattern with other OECD countries for which such decompositions are available (Elsby et al., 2008).

The originality of our contribution lies in documenting transitions to/from formal and informal work. The variance decomposition confirms that fluctuations in informal labor is a major driver of Argentine unemployment fluctuations. Three transition rates involving informality (job loss from informal work  $IU$  and job finding to informal work from unemployment  $UI$  and non-participation  $NI$ ) account for more than 60% of unemployment changes. In addition, the contribution of informality mainly lies in hirings rather than separations. Indeed, a substantial fraction of changes in the unemployment rate (45%) can be traced to the inflows to informal employment from unemployment  $UI$  and non-participation  $NI$ . In addition, for the job separation rate, job loss from informal employment  $IU$  accounts for 17.53% of unemployment variance, which is almost three times larger than the contribution of job loss of formal work ( $FU$  at 6.16%).

Column (2) of Table 3 displays the variance decomposition of the share of informal work in total employment. Nearly 40% of the changes in the informality rate is driven by fluctuations in the transition from informal to formal work ( $IF$ ). Job mobility alone from/to both types of employment ( $FI$  and  $IF$ ) account for 46% of changes in the share of informal work. Job finding rate to informal work from unemployment  $UI$  or non-participation  $NI$  account for approximately 36%.

To sum up, two major results emerge from this exercise. First, variations in informal

**Table 3:** Variance Decomposition based on  $\beta$ 

	Unemployment	Informality
	rate	rate
	(1)	(2)
<i>FI</i>	-1.46	6.91
<i>FU</i>	6.16	-2.36
<i>FN</i>	-1.22	-0.59
<i>IF</i>	1.30	38.91
<i>IU</i>	17.53	9.42
<i>IN</i>	-3.02	-2.52
<i>UF</i>	10.08	8.54
<i>UI</i>	36.56	17.88
<i>UN</i>	23.77	-4.65
<i>NF</i>	1.92	1.81
<i>NI</i>	8.30	18.09
<i>NU</i>	0.08	8.56
Separation: <i>FU</i> and <i>IU</i>	23.70	7.06
Finding: <i>UF</i> and <i>UI</i>	46.64	26.42
Non-participation : <i>NU</i> and <i>UN</i>	23.85	3.91
Job mobility : <i>FI</i> and <i>IF</i>	-0.16	45.82

"F" Formal employment, "I" Informal employment, "U" unemployment, "N" Non-participation.

"unemployment":  $\beta$  decomposition of changes in the unemployment rate. "informality":  $\beta$  decomposition of changes in the share of informal work in total employment.

(a) changes in *UI* account for 36.56% of fluctuations in the unemployment rate.

(b) changes in *IF* account for 38.91% of fluctuations in share of informal work in total employment.

employment are important drivers for unemployment fluctuations. Second, changes in the informality rate are driven by two major forces: (i), job mobility between the informal sector and the formal sector, especially changes in the stepping stone  $IF$ ; (ii), inflows from unemployment and non-participation. The result confirms the relevance of looking at labor participation when studying informality. The evolution of the stock of non participants in Figure 2 may suggest that labor participation does not play any role in the understanding of informality. Our paper shows that this conclusion is misleading, based on our analysis of worker transitions.

### 4.3 Argentine labor market during the crisis: counterfactual analysis

The previous section provides a quantitative assessment of the contribution of transition probabilities to fluctuations in the unemployment rate over the whole sample. We focus in this section on specific episodes: (i) the 1999-2001 recession marked by a surge in the unemployment rate and a constant informality rate; (ii) 2002-2004 where the unemployment rate starts declining and the informality rate undertakes an increase and (iii) the 2005-2008 recovery because we observe a strong decline in both informality and unemployment. These sub periods cover a broad spectrum of combinations of changes in unemployment and informal employment.

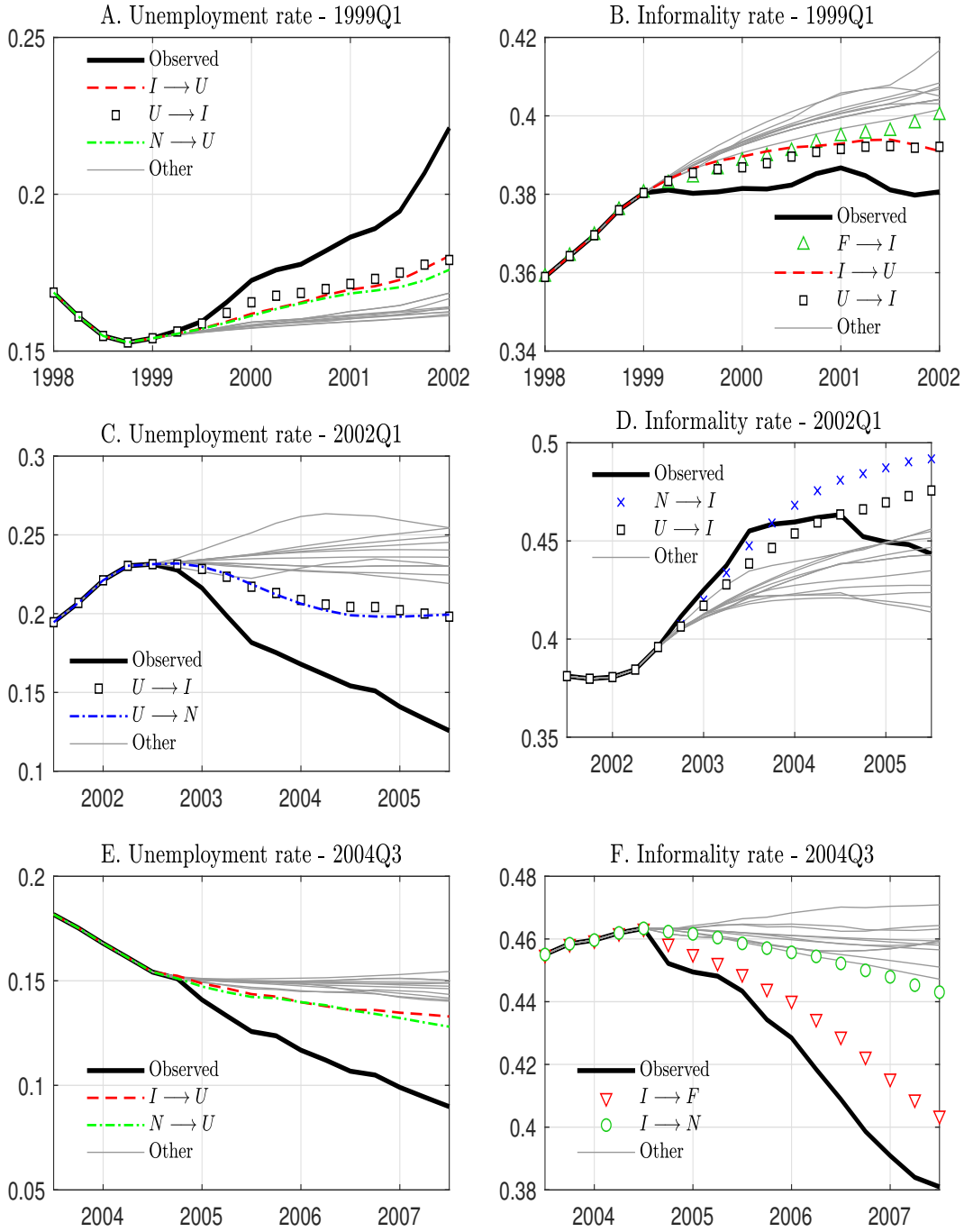
The objective is to answer the following question: what would have been the path of the unemployment rate and the informality rate if only one specific transition rate is allowed to fluctuate, the other rates are kept constant and set at the level observed at the beginning of the counterfactual exercise<sup>5</sup>? We have 12 independent transitions rates that can potentially drive changes in unemployment and informality rates. For the sake of clarity, we only highlight the transition rates that have the largest impact. With respect to Table 3, the counterfactual experiment provides a time-line in the story-telling of the recessions as some transition rates might play a role at the early stage of the recession while others affect unemployment dynamics as the recession unfolds. Results are reported in Figure 5.

We first examine the 1999-2001 recession where the counterfactual exercise starts in 1999Q1. Panel A displays the observed unemployment rate and the counterfactual unemployment rates that are predicted by the Markovian system when only one transition rate is allowed to fluctuate. From 1999Q2 to 2001Q1, the rise in the unemployment rate of about 4 percentage points seems driven by inflows to informal work from unemployment  $UI$ .

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<sup>5</sup>An alternative could be to consider that other rates are kept constant and set at their mean level from 1996Q3 until the start of the counterfactual. Our main results hold under this specification.

Figure 5: Counterfactuals



"F" Formal employment, "I" Informal employment, "U" unemployment, "N" non participation.

Changes in this transition rate alone closely match changes in the unemployment rate during the early stages of the recession, until 1999Q4. The declining hiring opportunities in informal jobs fueled the unemployment ramp up. After 1999Q4, the increase in the unemployment rate seems equally explained by the larger unemployment inflows from informal work and non-participation and by the separations from informal jobs.

Our results contrasts with the results found in the US. [Elsby et al. \(2010\)](#) point out that, in all US recessions, unemployment inflows account for a substantial fraction of unemployment variation early in the downturn, and then subside in the latter stages of the recession. The contribution of unemployment outflow rate becomes more dominant as each recession progresses. Our analysis on Argentine data reveals opposite results: unemployment outflows (the fall in hirings in informal work) contribute more at the early stage of the recession, while job separation from informal jobs contribute to the persistent increase in the unemployment rate in the latter stages of the recession. In addition, in year 2000, increases in unemployment inflows from non-participation  $NU$  fueled unemployment. This is suggestive of an added-worker effect (a temporary increase in the labor supply of married women whose husbands have become unemployed). We will explore further this point in [section 5](#).

From 2002Q1 onwards, the unemployment rate starts declining ([Panel C on Figure 5](#)) while the informality rate expands ([panel D](#)). Outflows from unemployment to informal work and non-participation mostly explain the fall in the unemployment rate. Consequently, the rise in hirings in the informal sector as well as the increase in labor force exits shape the declining profile of unemployment in the wake of the recession. The informality rate expands ([panel D](#)) due to hirings in informal employment, especially from non-participation  $NI$ . This suggests that informality is indeed an entry point to employment for non participants.

From 2004Q3 onwards, the unemployment rate keeps declining but for different reasons than those found in the previous sub periods. Indeed, the lower separation rate in the informal sector as well as the fall in labor market entries pick up the torch to explain the path of unemployment. The informality rate starts declining ([Panel E on Figure 5](#)). As more informal workers become formally employed, the informality rate falls. The flow  $IF$  solely accounts for 75% of the fall in the informality rate. Increased outflows to non-participation also play a role but to a lesser extent.

The main messages from the counterfactual exercise are the following:

- (i) Informality plays a key role in accounting for changes in unemployment. Indeed, fluctuations in the ability of unemployed to find informal jobs  $UI$  is a primary driver of unemployment changes, whether during the recession or at the early stage of the recovery. Separation from informal jobs accounts for the persistence of unemployment

ramp up at the later stage of the recession. Flows between unemployment and non-participation play a sizeable role whether in recession ( $NU$  for an added worker effect) or in the recovery ( $UN$  the reverse flow).

- (ii) The informality rate is driven by changes in different worker flows along the business cycle
  - At the early stage of the recovery, while the unemployment starts declining, informality *inflows* from non participation and unemployment drive the increase in the informality rate
  - At the later stage of the recovery, while the unemployment keeps declining, informality *outflows* to non participation and formal work drive the fall in the informality rate.

## 5 Heterogeneity across gender

In this section, we found suggestive evidence of an added-worker effect (hereafter, AWE), which refers to an increase in the labor supply of married women when their husbands become unemployed. The underlying theory is that married women are secondary workers with a less permanent attachment to the labor market than their partners. Literature on this topic showed that when the first worker suffers an income drop, the secondary worker enters the labor market (Mincer, 1962; Lundberg, 1985). More recently, Mankart and Oikonomou (2017) have detailed the mechanisms by which households insure their incomes against economic downturns. In the case of Argentina, the AWE seems to be confirmed by a recent study of Martinoty (2014) during the 2001 Argentine crisis and Bargain and Martinoty (2019) for Spain. Moreover, most studies point out the fact that the AWE is deepened when households face credit constraint (Lundberg, 1985; Bingley and Walker, 2001) as it is the case for Argentina. In this section, we investigate further this point by looking at worker flows by gender.

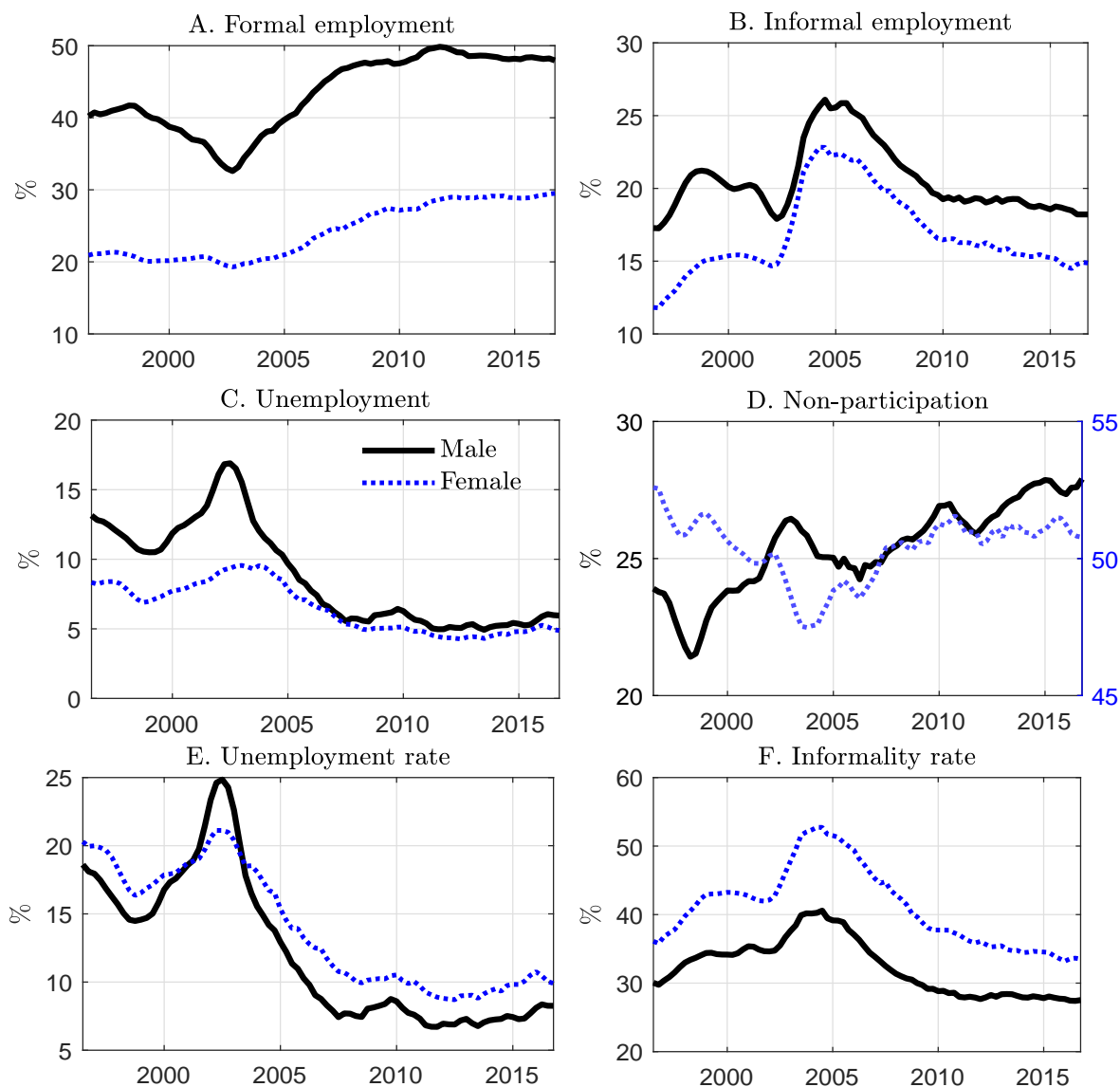
### 5.1 Evolution of labor stocks

We first take look at the variations in the stocks across gender (Figure 6). Panels E and F display the unemployment and informality rates across gender. Informal work is more prevalent in the female group than in the male group. Unemployment rate is also larger in the female group than in the male group, except in the second stage of the recession,



when the unemployment kept expanding beyond 20% for male workers after 2001. The 2001 economic slump had disproportionate employment effects on men.

**Figure 6: Stocks - Male vs Female**



Source : Argentine Household Survey. "F" Formal employment, "I" Informal employment, "U" unemployment, "N" non participation.

The Argentine 2001 crisis can then be labeled a "man-cession", a term coined during the 2007-2009 US recession when men held 70% of the job losses and when the male unemployment rate doubled. This term seem also relevant to characterize the Argentine 2001 crisis as the job lost in the recession where held by men whether in formal jobs (panel A) or

informal jobs (panel B). In contrast, female employment stock remained fairly stable during the crisis. In addition, non-participation (panel D) evolved in opposite direction across genders: in the crisis, more men left the labor market while women did the opposite.

As the economy recovers, after 2004, female informal employment declines and so does female participation. A sizeable fraction of male and female workers seems to enter formal employment. A look at worker transitions allows to analyze more precisely the flows across labor market status that drive these evolutions. We compute worker flows for men and women as described in section 3, with seasonal adjustment, margin-error correction and time-aggregation correction. The resulting adjusted transition probabilities are displayed in Figure 13 in Appendix C.

The striking difference concerns the non-participation inflows and outflows. Female workers are more likely to exit the labor force than males, whatever their initial status (employed or unemployed). The increase in the NU transition rates during the 2001 crisis is barely similar in magnitude for males and females. In addition, they are less likely to enter the labor force on average. Notable exceptions concerns job finding rates in the formal and informal sectors in the trough of the 2001 recession. The NI and NF flows of female workers slightly exceed the ones of male workers. Given that the number of females non-participant was higher than that of males at that time, labor market entries directly to employment was larger. This result suggests that the increase in participation is characterized by a particular form of the added-worker effects. It translates through more unemployed workers but also more hirings, especially in the informal sector. Understanding how large is their respective contribution to unemployment rate is the purpose of the next section.

Important differences can also be traced to the outflows from informality. Formalization of informal jobs (IF) are weaker on average for females than for males. However, from 2002 onward the increase in the IF flows has been stronger for female than for males. Since the IN flows doubles over the same period one may wonder how much of the decline in informality is accounted for by formalizations and labor force exits. This is we aim at investigating now.

## 5.2 Variance decomposition

Table 4 decomposes the contribution of the different flows by gender for fluctuations in the male and female unemployment rate (columns (1) and (2)). For male and female workers, the most important contribution to unemployment rate variations remains the unemployment outflow towards informality  $UI$ . Changes in hirings of unemployed workers in informal jobs accounts for 38% (31%) of male (of female) unemployment fluctuations. The main difference across gender lies in flows involving non participation.  $UN$  flows account for 28.35% of

female unemployment changes (versus 9.25% for male). Outflows from non-participation to informal employment  $NI$  or unemployment  $NU$  account for 27% of female unemployment changes versus 9% for male unemployment rate. Finally, we also observe sizeable differences across gender in  $FU$  flows which matters for males but not at all for females in explaining unemployment changes.

**Table 4:** Variance Decomposition by gender based on  $\beta$

	Unemployment		Informality	
	rate		rate	
	Men	Women	Men	Women
	(1)	(2)	(3)	(4)
$FI$	0.06	-2.60	12.98	9.17
$FU$	10.32	0.03	-4.07	1.33
$FN$	-0.84	-1.47	0.89	-1.18
$IF$	3.01	-0.23	35.47 (b)	35.38
$IU$	21.53	12.81	10.88	5.90
$IN$	-1.98	-4.36	1.28	-1.41
$UF$	9.88	7.23	8.13	6.94
$UI$	37.92	30.74 (a)	19.80	14.66
$UN$	9.25	28.35	-4.50	-2.83
$NF$	1.70	2.24	0.38	2.95
$NI$	5.35	12.39	10.58	23.56
$NU$	3.79	14.87	8.19	5.52
separation: $FU$ and $IU$	31.85	12.84	6.81	7.23
finding: $UF$ and $UI$	47.80	37.97	27.93	21.60
non-participation : $NU$ and $UN$	13.05	43.22	3.68	2.70
job mobility : $FI$ and $IF$	3.06	-2.83	48.45	44.55

"F" Formal employment, "I" Informal employment, "U" unemployment, "N" Non-participation.

"unemployment":  $\beta$  decomposition of changes in the unemployment rate. "informality":  $\beta$  decomposition of changes in the share of informal work in total employment.

(a) changes in  $UI$  account for 30.74% of fluctuations in the female unemployment rate.

(b) changes in  $IF$  account for 35.47% of fluctuations in share of informal work in total male employment.

Fluctuations in the job-to-job mobility ( $FI$  and  $IF$ ) still explain a large share of changes in the informality rate (columns (3) and (4) in Table 4), especially the propensity of formalization captured by the transition  $IF$  that accounts for 35% of changes in the informality rate for men and women. The main difference across gender lies in the contribution of  $NI$  that is twice larger for women (24%) than for men (11%). Finally, job losses from informal jobs account for 11% of the change in male informality rate, which is twice larger than that of female informality rate (6%).

### 5.3 Counterfactual exercises

We now analyze the counterfactual experiment performed at different points in time of the business cycle on male and female workers. Figure 7 displays counterfactual exercises for the unemployment rate.

During the 2001 recession (panels A and B) as well as in the subsequent recovery (panels C and D), changes in unemployment exits into informal jobs  $UI$  is a major driver of unemployment fluctuations, whether for male or female workers. A striking feature of the crisis lies in the increase in unemployment inflows from non-participation for women: the counterfactual female unemployment rate predicted by the changes in  $NU$  alone closely tracks the observed unemployment rate (panel B), which is not the case for male workers (panel A). This is suggestive of the added-worker effect. Panels A and B also illustrate the different role played by job losses of informal jobs: for male workers (panel A), in the recession, job losses in informal employment increased on the onset of the recession; in contrast, for female workers (panel B), job losses in informal jobs  $IU$  were important at the later stage of the recession, after 2002Q2 (when flows  $UI$  and  $NU$  stabilized while  $IU$  kept increasing).

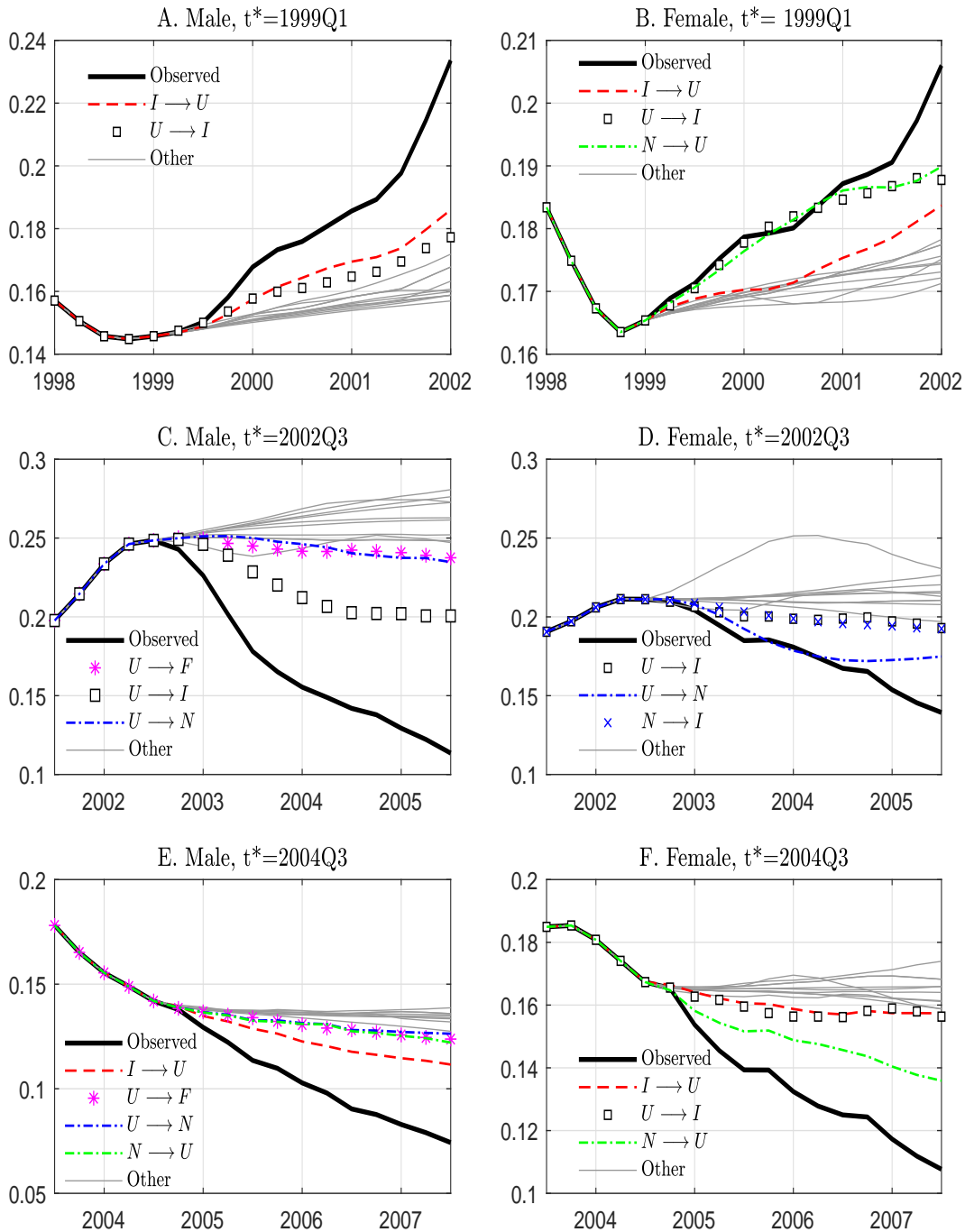
In the early stages of the recovery (panel C and D of Figure 7), the striking difference between male and women lies in the leading role of  $NI$  transitions in the decline of female unemployment rate, which is not the case for male unemployment. While the decline in the male unemployment rate was mainly driven by hirings into informal jobs from unemployment  $UI$ , female unemployment fell because (i) more women were leaving the labor force and (ii), less women enter the labor force from non-employment to unemployment. Both of them are suggestive of a "reverse added-worker effect".

Figure 8 displays the counterfactual experiments for the male and female informality rate in the recession (panels C and D). The informality rate is on the rise with increasing inflows from non-participation for male and female workers  $NI$ , and improved job prospects for male and female unemployed ( $UI$  increases). Male workers differ from female workers along one dimension: while the female informality is mainly driven by  $NI$ , the male informality is driven by a combination on  $UI$ ,  $NI$  and the drop in job losses  $IU$  that also contributed to the increase of the male informality.

Figure 8 reports counterfactual exercises at the point of the great reversal of informality. After 2004Q3, informality provides a stepping stone towards formal employment  $IF$ , which brought informality rate downwards for male and female workers (panels E and F).

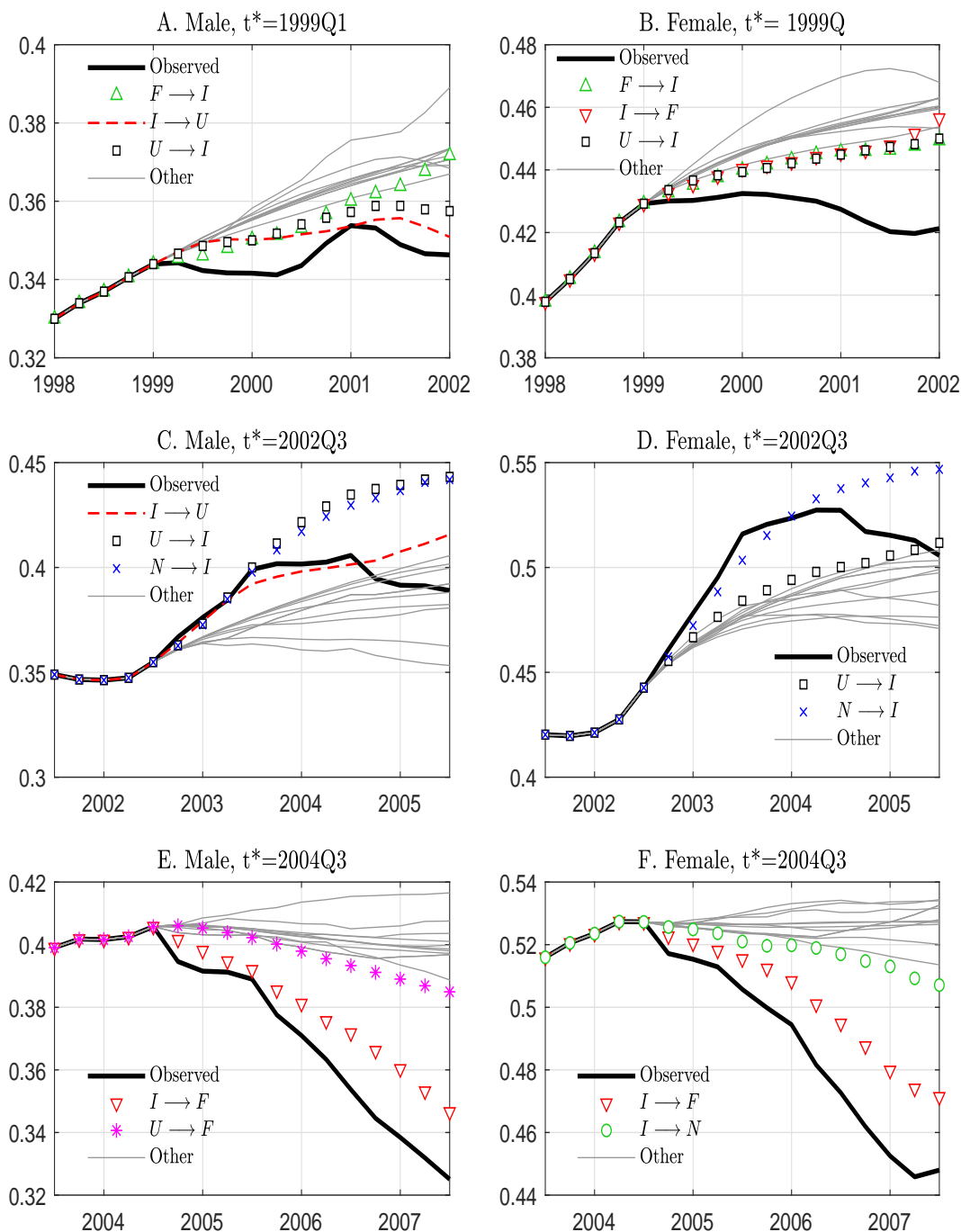
Our results suggest that formalization of informal employment (through changes in  $IF$ ) played a leading role in the decline of male and female informality rate. Our results also suggest that other worker flows shall not be neglected as they also affect the informality rate:

**Figure 7: Counterfactual unemployment rate - Male vs Female**



Source : Argentine Household Survey. "F" Formal employment, "I" Informal employment, "U" unemployment, "N" non participation. Reading: what would have been the path of the variables if only one transition rate varies, the rest of the transition rates being held constant at their level at the beginning of the counterfactual exercise?

**Figure 8: Counterfactual informality rate - Male vs Female**



Source : Argentine Household Survey. "F" Formal employment, "I" Informal employment, "U" unemployment, "N" non participation. Reading: what would have been the path of the variables if only one transition rate varies, the rest of the transition rates being held constant at their level at date  $t = t^*$ ?

the ability of unemployed workers to find a formal job  $UF$  also matters for male workers (panel E), while female labor market participation  $IN$  affect their informality rate (panel F).

## 6 2009-2010 Hiring credits policy

In this section, we want to illustrate the insight one can get from our work when analyzing the effects of a specific labor market policy. We consider a policy implemented in Argentina in the aftermath of the 2008 crisis and look at the worker flows after the implementation of the policy using counterfactual exercises. We only provide here a tentative assessment of the effects of the economic policy on worker flows. A proper assessment should undertake rigorous identification strategies. Our counterfactual exercises below provide an illustration of how our time series can be used for future research.

### 6.1 The policy

As many countries, Argentina has launched an ambitious hiring credits policy to cancel out the 2008 crisis effect on labor market. This policy, announced in December 2008 and effective by the end of the month<sup>6</sup>, is known as the "Régimen de regularización impositiva, promoción y protección del empleo registrado, exteriorización y repatriación de capitales". The main objective was to maintain the formal employment level and to offer an incentives to formalize informal workers.

The main targets of the plan are small and medium size firms. The law provides an amnesty of social security debt and sanctions for firms up to ten employees that formalize informal workers. Firms with more than ten workers also have the possibility to access this debt and sanctions cancelation for the first ten formalized employees and to delayed the repayment for the others. The law also includes a reduction in the employer's social security contributions of fifty percent the first year and twenty five percent the next year for all new hires without restriction on firms' size. The law had an initial horizon of one year but was extended every year until 2014. According to the study by the Argentine Ministry of Labor, Employment and Social Security<sup>7</sup> (MTEySS, in Spanish) the impact of the law is important. Their estimations suggest that the number of firms affected by the law was about 85 000 and the number of employees was 408 000 (nearly 4% of the formal labor force) by the end of 2009.

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<sup>6</sup>The timing of the policy implementation ruled out any anticipation effects.

<sup>7</sup>See [MTEySS and ILO \(2012\)](#)

Other countries like France implemented a hiring credit policies. [Cahuc et al. \(2017\)](#) investigated its impact over the period 2009-2010 on employment using difference-in-difference estimation method. They show that it had significant positive employment effects and no effects on wages. Our exercise cannot be viewed as an evaluation of the Argentine hiring credits on informality and employment level. The effect of the post 2001 crisis recovery, the 2008 international crisis and the hiring credits cannot be disentangled. Nonetheless, we think that our findings could lead to future research.

## 6.2 Counterfactual exercises

We perform a counterfactual exercise to explore the impact of the reform on worker flows: we plot the counterfactual informality rate predicted if only one worker transition is allowed to fluctuate, the other transition rates are set at their value observed at the beginning of the counterfactual exercise (2009Q1).

When the policy was implemented, the informality rate had already started declining (Figure 10). From 2009Q1 until 2010Q1 the fall in the aggregate informality rate was actually driven by changes in flows between informal work and non-participation: the fall in informality inflows from non-participant (less  $NI$ ) combined with the increase in informality outflows (more  $IN$ ) led to a declining informality rate.

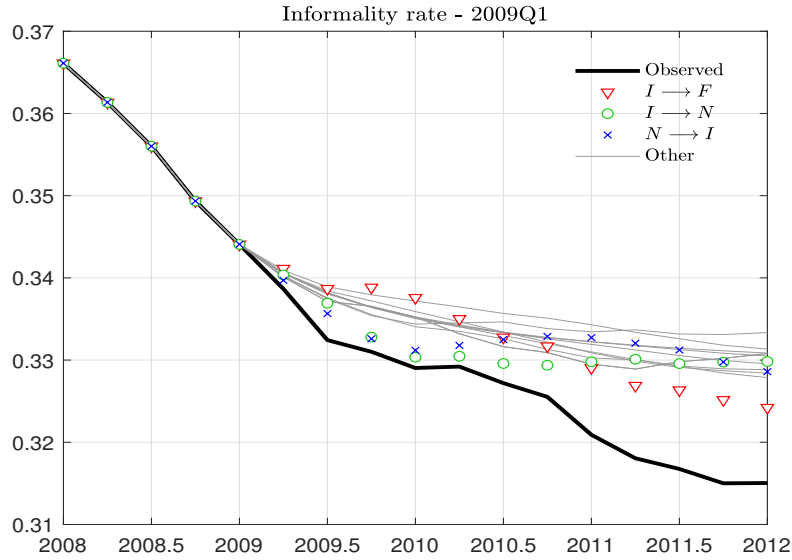
After 2010Q1, the informality rate kept dropping due to the increase in formalization of informal jobs  $IF$ . While formalization of informal jobs was one of the targets of the law, worker transitions from informal to formal jobs  $IF$  actually responded to the law with a 1-year lag. Immediate changes in informality rate actually came from informality ins and outs from/to non-participation.

Figure 10 supplements our analysis by displaying the counterfactual exercise for male and female workers. The decline in the male informality rate was driven by changes in the ins and outs of informal employment from/to non-participation ( $IN$  and  $NI$ ). It is noticeable that male workers also benefited from a lower propensity of job-downgrading from formal to informal job  $FI$  (as can be seen from Figure 13). Fewer male workers in formal jobs were downgraded to an informal status (left panel of Figure 10) while more female workers in informal jobs were upgraded to a formal status  $IF$ .

The empirical evidence suggests that the Argentine labor market carried on with its formalization, which affected male and female workers. The policy affected not only job-to-job mobility between formal and informal jobs but also ins and outs of informality to/from non-participation, which highlights the importance of measuring all worker flows when analyzing the Argentine labor market.

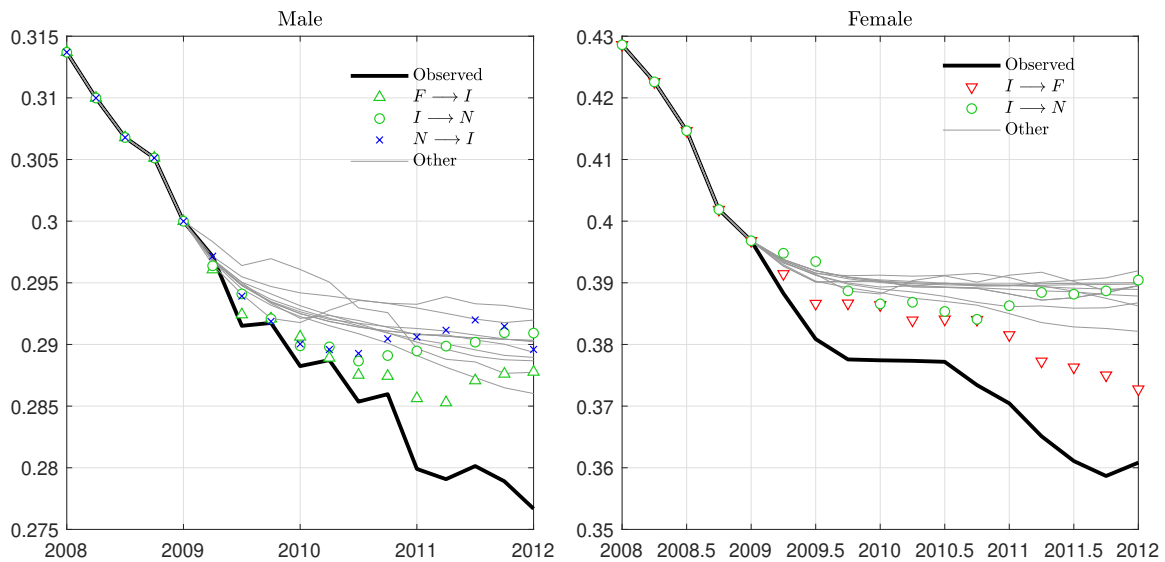


**Figure 9: Counterfactual informality rate**



Source : Argentine Household Survey. "F" Formal employment, "I" Informal employment, "U" unemployment, "N" non participation. Reading: what would have been the path of the variables if only one transition rate varies, the rest of the transition rates being held constant at their level at date  $t = t^*$ ?

**Figure 10: Counterfactual informality rate**



Source : Argentine Household Survey. "F" Formal employment, "I" Informal employment, "U" unemployment, "N" non participation. Reading: what would have been the path of the variables if only one transition rate varies, the rest of the transition rates being held constant at their level at date  $t = t^*$ ?

## 7 Conclusion

Understanding movements in inflows and outflows of workers has now become the conventional approach for studying the labor market dynamics. Worker flows provide a rich story about labor adjustments along the business cycle and the driving forces behind the cyclicity of the stocks. Beyond traditional decomposition exercises time series of worker flows are useful for the calibration and estimation of theoretical frameworks. There is now a vast literature that strive to find what theoretical foundations are relevant for reproducing salient facts from the data. Some of them are well captured while other are still puzzling.

Notwithstanding, these studies are possible as long as time series are available. In emerging countries, worker flows are still difficult to compute over a sufficiently large period, a prerequisite for the analysis of the labor market at business cycle frequencies. In this paper we tackle this issue by building transition rates in Argentina over the last two decades, including the deep recession in 2001. In addition, the Argentina labor market involves upswing and downswing in the unemployment rate and the informality rate, providing an interesting environment for analyzing the contribution of the inflows and outflows at different point of the cycle. Our work provides novel evidence on worker flows in emerging countries and can be used to discipline theoretical frameworks embedding an informal sector.

The major challenge we face consists in bridging the gap between two different samples due to the survey re-design that occurs between 2002 and 2003. This difficulty is not inherent to our data and many researchers may encounter similar problems with alternative data. As such, the proposed solution can be applied on a wide set of problems in economics. Our methodology consists in adjusting the Markovian representation of quarterly labor market transitions such that the dynamic system replicates the observed semi-annual worker flows before 2003. After applying a piecewise interpolation on the semi-annual data, we end up with quarterly transitions observed at quarterly frequencies, from 1996Q2 to 2017Q2.

The decompositions and counterfactual exercises performed on the transition rates show that the ins and outs of informal employment are key drivers of labor market fluctuations. Outflows from unemployment to informal employment solely account for 37% of the fluctuations in the unemployment rate. We wonder whether informal employment is a stepping stone to formal employment. Our simulations suggest that it is the case but the decline in the informality rate observed since 2005 is also attributable to labor market exits. This stylized fact naturally raise the question of whether the *Added-worker effect* is the relevant mechanism to describe the evolution of the participation margin. This phenomenon explains one third of the rise in unemployment between 1999Q1 and 2002Q3 and essentially belongs to female workers. However, a significant share of male and female workers enter

the labor market directly in informal work. This particular form of the added-worker effect suggests that informality is a very flexible sector that is used in recessionary periods as a buffer against income losses.

We then examine the effects of hiring credits implemented in Argentina in 2009. The empirical evidence suggests that the policy affected not only job-to-job transitions between formal and informal jobs but also ins and outs of informality to/from non-participation, which highlights the importance of taking into account all worker flows when analyzing the Argentine labor market.

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# Appendix

## A Data

### A.1 Handling discontinuity in Argentine survey data

Gomes (2015) notices that labor market transition rates can be estimated from survey data with various frequencies (whether monthly in US data or quarterly in French, UK or Spain). He proposes a methodology to make them comparable. While his work relates to international comparisons of labor market transition rates, we apply his suggestion to handle the discontinuity in Argentine data.

Consider a labour market with four states: employment in the formal sector (F), employment in the informal sector (I), unemployment (U), and non-participation to the labor market (N). Each period  $t \in 0, 1, 2, 3, \dots$  corresponds to the frequency of individual interviews. Let us first consider quarterly data (after 2003 in Argentine data). Using quarterly surveys, we compute the transitions between  $t$  and  $t + 1$  recorded in a  $4 \times 4$  discrete time Markov transition matrix  $n_q$ , with columns summing to 1. We can then compute the quarterly transition matrix (denoted  $\hat{n}_m$ ) from the quarterly discrete transition matrix. We will then get quarterly labor market transitions observed at a quarterly frequency. Notice here the subtle difference between the frequency of observations and the time dimension of labor market transitions. The quarterly dimension in the data can be seen, for instance, when we use labor market transitions to compute unemployment duration (as the inverse of the probability for an unemployed worker to find a job). The number we get will be expressed in terms of numbers of quarters. Similarly, the average duration of a job (computed as the inverse of the probability for an employed worker to become unemployed) is expressed in quarters. These statistics will be available at a quarterly frequency. We choose to focus on quarterly labor market transitions as this is the most standard time dimension used in labor market models (such as Mortensen, 1994; Pissarides, 2011).

The methodology is the following. First, the quarterly transition matrix  $n_q$  can be decomposed as  $n_q = p_q \mu_q p_q^{-1}$  with  $\mu_q$  is a diagonal matrix of eigenvalues  $n_q$  and  $p_q$  the matrix of associated eigenvectors. Secondly,  $n_q$  is such that

$$n_q = \hat{n}_m \times \hat{n}_m \times \hat{n}_m$$

The solution to this equation is then

$$\hat{n}_m = p_q (\mu_q)^{\frac{1}{3}} p_q^{-1} \tag{5}$$

We proceed in a similar way when using semi-annual survey data to get quarterly transition rates:

$$\hat{n}_m = p_q(\mu_s a)^{\frac{1}{6}} p_s a^{-1} \quad (6)$$

where subscript  $sa$  refers to semi-annual frequency of interviews. As a result, after treating pre-2003 semi-annual surveys, we get quarterly labor market transitions observed at a semi-annual frequency. After treating post-2003 quarterly data, we get quarterly labor market transitions observed at a quarterly frequency. In order to get quarterly observations throughout the period, we use a piecewise interpolation on pre-2003 semi-annual data.

## A.2 Margin error

The goal of margin-error adjustments is to address the discrepancy between the stocks and the gross flows. The stocks are computed using the whole sample of cross-sectional data; the gross flows, on the other hand, require longitudinal linking, and therefore their measurement suffers from sample attrition, imperfect matching, etc. The margin-error adjustment below reconciles the predicted changes in stocks with the actual changes calculated on stocks using the whole sample of cross-sectional data.

[Elsby et al. \(2015\)](#) rewrite the dynamics of changes in the observed stocks  $\Delta l_t$  as a function of stock-consistent transition probabilities  $p_t$  and stocks from previous period  $S_{t-1}$ .

$$\Delta l_t = S_{t-1} p_t \quad (7)$$

From the data, we can only get transition probabilities that are not fully stock-consistent, which we denote  $\hat{p}_t$ . In order to recover stock-consistent transition probabilities  $p_t$ , [Elsby et al. \(2015\)](#) minimize the weighted sum of squares of margin-error adjustments under the constraint of equation (7)

$$\text{Min } (p_t - \hat{p}_t)' W_t^{-1} (p_t - \hat{p}_t) \quad (8)$$

where  $W_t$  is a weighing matrix proportional to the covariance matrix of  $\hat{p}_t$ . The solution of this minimization problem is  $\hat{p}_t$  as a function of the observed data :  $p_t$ ,  $\Delta l_t$  and  $S_{t-1}$ .

## A.3 Time aggregation

Let us denote  $H_t$  the continuous-time analog of  $X_t$ . If the eigenvalues of  $H_t$  are all distinct, then  $H_t$  can be written as:  $H_t = V_t C_t V_t^{-1}$ , where  $C_t$  is a diagonal matrix of eigenvalues and  $V_t$  is the matrix of associated eigenvectors. Furthermore, one can show that  $X_t$  can be decomposed as:  $X_t = V_t D_t V_t^{-1}$  where  $D_t$  is a diagonal matrix whose elements are the

exponentiated eigenvalues in  $C_t$ , and that this relationship is unique if the eigenvalues of  $D_t$  are, in addition to distinct, real and nonnegative. These relationships can be used to obtain time series of estimates of the adjusted hazard rates  $\lambda_t^{ij}$ . In every period  $t$ , we compute the eigenvalues of the discrete transition matrix  $X_t$  and check whether they are all distinct, real and nonnegative. We then take their natural logarithm to obtain the eigenvalues of the continuous-time analogue  $H_t$ . Finally, we compute  $\lambda_t^{ij}$ , and use the relationship:  $p_t^{ij} = 1 - e^{\lambda_t^{ij}}$  to obtain a series of time-aggregation adjusted transition probabilities.

## B Margin error correction and non-steady-state analysis are relevant when analyzing the Argentine labor market

Previous paper on worker flows with informal labor market perform a steady state analysis, without correcting for margin error. This method was developed by [Shimer \(2012\)](#) using US data. This approach is relevant in the US labor market as it is characterized by a high turnover and high-quality micro data. We illustrate in this Appendix that this approach is not relevant in the analysis of Argentine labor market, a labor market with low turnover and survey data of lower quality than its US counterpart.

### B.1 Steady state approach as in [Shimer \(2012\)](#)

Considering a labor market with 4 possible states (employment in formal and informal sector, unemployment, and inactivity), let us assume a population of working age that is constant over time, the evolution of labor market stocks is described as a Markovian process

$$X_t = p_t X_{t-1} \quad (9)$$

where  $X_t = (F_t, I_t, U_t, N_t)$  denote the 4 labor market stocks *i.e.* formal employment, informal employment, unemployment and non participation.  $p_t$  is a square matrix of size 4, whose elements  $p_{i,j}$  capture the transition probability from labor status  $i$  to labor status  $j$ .

The decomposition methodology proposed by [Shimer \(2012\)](#) uses the concept of the steady-state probability,  $X_t^*$ , which is calculated under the assumption that for each period the transition matrix  $p_t$  is constant in subsequent periods and that the state probability for  $h$  periods ahead,  $X_{t+h}$ , converges to  $X_t^*$  when  $h$  grows to infinity. Assuming convergence,  $X_t^*$  can be calculated by solving the following system:

$$X_t^* = p_t X_t^* \quad (10)$$



The rate at which the system converges to  $X_t^*$  depends on certain properties of the transition matrix: in particular, for labor market with high turnover rates, such as the US, convergence is fast. When convergence is sufficiently fast, the vector  $X_t^*$  provides a good approximation to labor market stocks  $X_t$  and the current unemployment rate,  $u_t$ , can be well approximated by the long-term rate of unemployment computed using steady state labor market stocks  $X_t^*$ .

Several elements can actually lead steady state labor market stocks  $X_t^*$  to differ from actual labor market stocks. First, [Elsby et al. \(2013\)](#) argue that steady state rate does not provide an accurate description of the fluctuations in the current rate for countries that display slower unemployment dynamics. Argentina was not in their sample but we suspect that Argentina falls in this category. This Appendix explores this point. Secondly, [Elsby et al. \(2015\)](#) stress that gross flows are susceptible to classification errors in recorded labor market status. While such errors may largely cancel in measured labor market stocks, they can accumulate in estimates of worker flows, inducing spurious measured transitions. [Elsby et al. \(2015\)](#) then develop a correction for margin error that restricts the estimates of worker flows to be consistent with the evolution of the corresponding labor market stocks. We follow their approach by discarding the steady state approach and computing stock-consistent transition probabilities.

## B.2 Evolution of labor market stocks

Figure 11 displays the labor market stocks from EPH data and the steady state stocks computed as in [Shimer \(2012\)](#). Let us stress again that stocks from EPH data are computed using *all individuals* in the survey data each quarter. The EPH time-series are then the most reliable as it uses all the information available each period. In contrast, steady state stocks are computed based only on *longitudinal* data: only the workers that could be matched from one survey to the next are considered in the steady state stocks. With high quality survey data, longitudinal data and cross-section data yield very similar time-series as matching-rate from one survey to the next is high, and preserves representativeness of the sample.

The discrepancies between the two times series illustrate the impact of the steady state approach as well as low quality of survey data. While the general evolution of stocks (formal employment, informal employment and unemployment) look similar, there are sizeable discrepancies between the time-series.

First, all steady state stocks seem to lead the actual evolution of stocks by 2 to 3 quarters. For instance, unemployment stock peaks at 2002Q2 while the peak occurs at 2001Q1 for the steady-state stocks. As a result, counterfactual exercise would deliver the

Figure 11: Data versus steady state: employment stocks



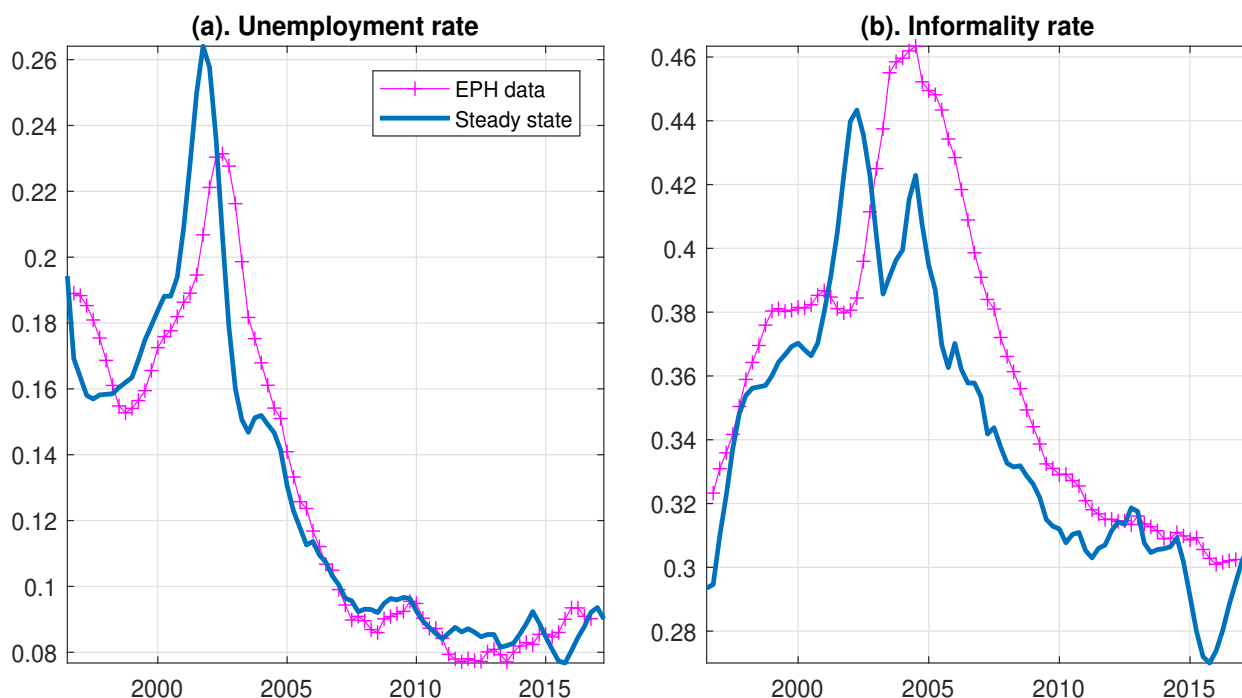
"EPH" : stocks from Argentine Household Survey. "steady state": steady state stocks from worker flows without error margin correction.

wrong timing with respect to the analysis of the crisis or credit hiring. This is a strong limitation of the steady state data with respect to policy evaluation and business cycle analysis. We suspect that this lag is due to the steady state analysis, as this approach assumes that the unemployment rate is at the steady state each period, which is relevant for labor markets with high turnovers, such as the US. The lag on Figure 11 suggests that this is not the case for Argentina.

Secondly, the steady-state time-series departs from EPH at several points in time: steady-state stocks display ups and downs that are absent from EPH data, such as formal employment at the beginning of the sample; all steady state stocks from 2015Q4 to 2017Q3. This illustrates that longitudinal data might not sometimes deliver representative samples, such that stocks computed only from matched-individual does not exhibit the same evolution as stocks computed from all EPH data.

Figure 12 exhibits the unemployment and informality rates from EPH data and steady state analysis. Even though the correlation between EPH data and steady-state analysis is high (0.92 for the unemployment rate and 0.85 for the informality rate), steady-state data still leads the actual time-series by 2 to 3 quarters, display ups and downs in 2015-2016 that are absent from EPH data and the informality rate exhibits twin peaks in 2002-2004 that are absent from the data.

**Figure 12: Data versus steady state: Unemployment rate and informality rate**



*"EPH" : unemployment rate and informality rate from Argentine Household Survey. "steady state": steady state unemployment rate and steady state informality rate from worker flows without error margin correction.*

In our paper, the error correction margin aims at correcting worker flows such that they are actually consistent with the evolution of EPH data. We thereby also correct for potential longitudinal matching problems from one survey to the next. In addition, it is a non-steady state analysis. As a result, in our paper, the labor market transitions are such that the Markovian model replicates the actual unemployment and informality rates, with the right business cycle dates of expansion and recessions.

### B.3 Variance decomposition

Table 5 reports the variance decomposition using the steady-state approach (columns (1) and (3)). We report the  $\beta$  decomposition of unemployment fluctuations (measured as first-

difference of steady-state unemployment). The benchmark results from Table 3 are displayed in columns (2) and (4).<sup>8</sup> The steady-state approach yields misleading conclusions about the contribution of worker flows to unemployment changes, in particular it underestimates the contribution of job finding rates of informal jobs ( $UI$ ) and inflows into non-participation from unemployment ( $UN$ ), while it overestimates the role of job losses ( $IU$  and  $FU$ ) in unemployment changes.

**Table 5:** Variance decomposition: comparing methodologies

	unemployment rate		informality rate	
	(1)	(2)	(3)	(4)
	SS	Non-SS, MEC	SS	Non-SS, MEC
FI	3.00	-1.46	26.24	6.91
FU	10.17	6.16	4.45	-2.36
FN	0.97	-1.22	1.15	-0.59
IF	6.41	1.30	40.73	38.91
IU	25.41	17.53	-2.77	9.42
IN	-0.82	-3.02	3.06	-2.52
UF	14.18	10.08	13.42	8.54
UI	17.16	36.56	1.21	17.88
UN	7.80	23.77	-0.29	-4.65
NF	5.92	1.92	9.43	1.81
NI	6.52	8.30	3.77	18.09
NU	3.29	0.08	-0.41	8.56
separation: FU and IU	35.57	23.70	1.68	7.06
finding: UF and UI	31.34	46.64	14.64	26.42
non-participation : NU and UN	11.09	23.85	-0.70	3.91
Job mobility : FI and IF	9.40	-0.16	66.97	45.82

(1) and (2): variance decomposition of changes in the unemployment rate

(3) and (4): variance decomposition of changes in the informality rate

"SS": Steady state analysis, no margin error correction

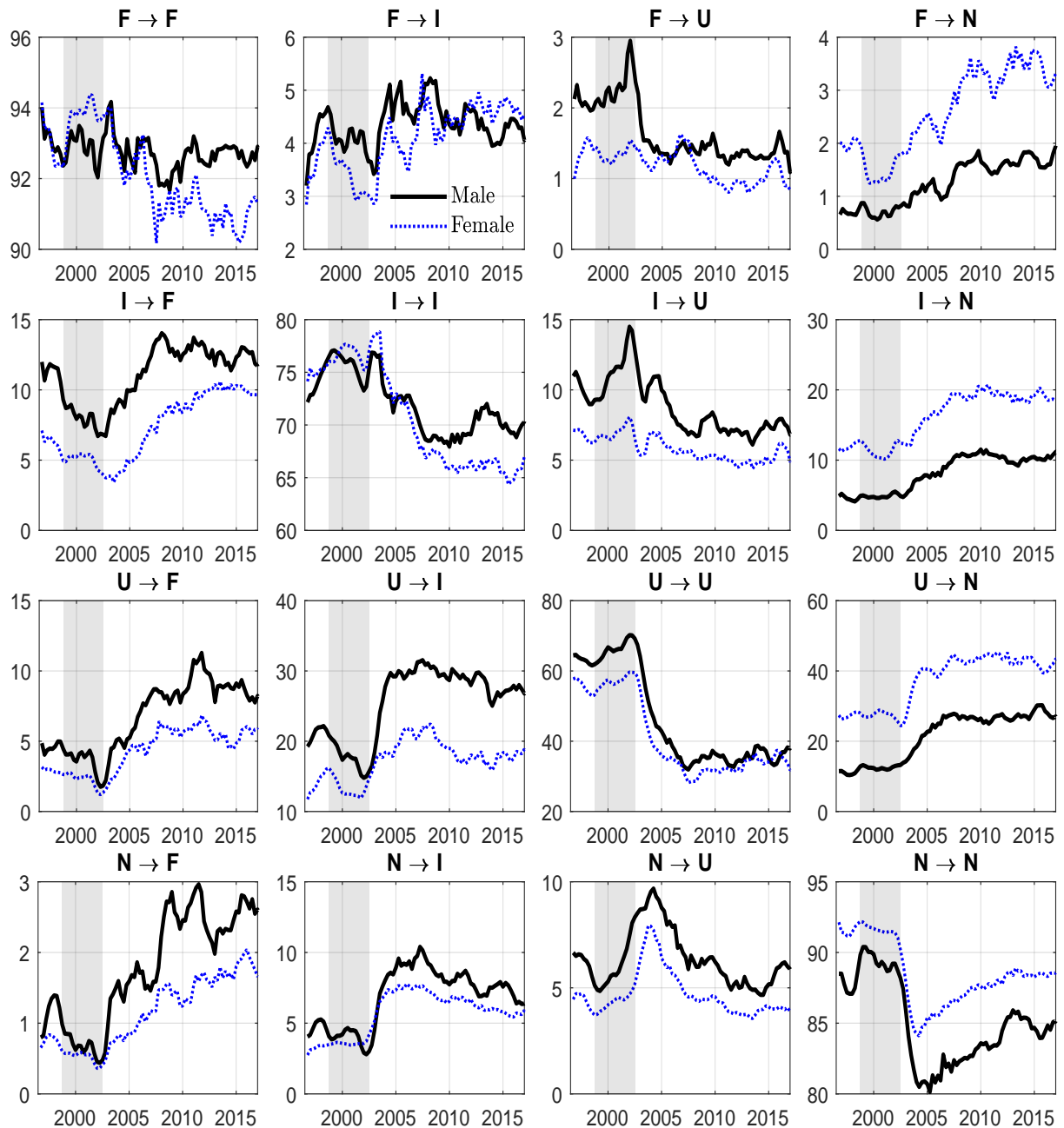
"Non-SS, MEC": Non-Steady state analysis, margin error correction. Same results as in Table 3.

For the informality rate, the striking feature is the contribution of  $UI$  which appears as very low in the steady state approach, while the contribution of  $FI$  appears large. The variance decomposition conveys a biased picture of the contribution of worker flows to the understanding of changes in the informality rate.

<sup>8</sup>Notice that short-run fluctuations are captured with first-difference in all columns of Table 3. Hence, the difference across columns is not due to filtering methods to identify short-run changes.

## C Evolution of transition probabilities

Figure 13: Transition probabilities - Males vs Females



Source : Argentine Household Survey. "F" Formal employment, "I" Informal employment, "U" unemployment, "N" non participation. Shaded area denotes period with positive growth of unemployment rate.