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## Remittances, Entrepreneurship, and Employment Dynamics over the Business Cycle

Alan Finkelstein Shapiro and Federico S. Mandelman

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**Abstract:** We incorporate remittances and microentrepreneurship (self-employment) into a small open-economy business cycle model with capital and labor market frictions. Countercyclical remittances moderate the decline of households' consumption during recessions. These remittances also are used to finance the start-up costs of microenterprises that bolster households' income during economic downturns. However, the positive income effect from countercyclical remittances also leads to a decrease in salaried labor supply, which generates offsetting upward pressure on wages during recessions and adversely affects the recovery of the salaried sector. Therefore, the behavior of remittances decisively affects labor force participation and the composition of employment between nonsalaried and salaried employment over the business cycle. The model delivers labor market and aggregate cyclical dynamics that are consistent with the Mexican data.

JEL classification: E24, E32

Key words: business cycles, search and matching frictions, remittances

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# 1 Introduction

Migrants' remittances represent an increasingly important source of income for many developing countries. Conservative figures estimate these foreign inflows at USD\$404 billion in 2013. This is equivalent to 36 percent of the total private net capital flows (including foreign direct investment, portfolio equity and private debt) to all low- and middle-income countries.<sup>1</sup> Particularly impressive is the growth of these flows. Accounting for less than USD\$85 billion in 2000, these flows had posted an average annual growth of 12 percent during subsequent years. Remittances also are volatile and usually countercyclical as they tend to increase when recipient households face adverse economic conditions.<sup>2</sup> In addition, recent surveys show that the rapid surge of remittances is having a decisive impact on the dynamics of the microenterprise sector in developing countries. These migrant transfers are used increasingly to finance the start-up and operating costs of microenterprises, with potentially important effects on employment and aggregate activity.

Self-employment and microenterprise development also play a crucial role in most emerging and developing economies. The self-employed can account for anywhere between one-third to four-fifths of the labor force. Furthermore, the microenterprise sector is populated mostly by own-account workers. These individuals often receive help from friends and family members to operate their small firms but do tend to not hire salaried workers.<sup>3</sup> Despite their micro scale, the self-employed are often capital-constrained and must rely on external financing from other (larger) firms. The latter usually supply intermediate goods or capital inputs in the form of trade credit to the self-employed. Importantly, existing evidence suggests that self-employment tends to expand during recessions, particularly as people flow out of unemployment and into self-employment. Thus, self-employment often can act as a partial income

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<sup>1</sup>This group consists of 137 countries (including upper-middle income economies). Remittances represent more than 15 percent of the GDP in seven Latin American and the Caribbean economies. See Sirkeci, Cohen, and Ratha (2012) for more details. For Mexico, the world's 11th largest economy in PPP, the figure is 2.5 percent. These are conservative estimates since many remittances are transferred through informal channels that are not included in the official records.

<sup>2</sup>While remittances tend to be countercyclical with respect to the country where recipient households live, they are generally procyclical with respect to the country where immigrants reside and generate their income (Mandelman and Zlate, 2012). In part, this explains the 5 percent decline in remittances during the global financial crisis of 2008-2009.

<sup>3</sup>See Loayza and Rigolini, 2011.

protection strategy in economies where proper safety nets are either limited or non-existent.

Despite the relevance of remittance inflows and the importance of self-employment in shaping the structure of labor markets in developing countries, the macroeconomic literature has devoted little attention to either one. Moreover, to the best of our knowledge, there are no studies that link these two factors in a comprehensive environment. Our goal is to bridge this gap by incorporating them into a workhorse small-open economy business cycle model with capital and labor market frictions. These two frictions are needed to both study frictional unemployment and capture the cyclical dynamics of employment. Up to the global financial crisis of 2008-2009, we rely on Mexican data to parametrize the model and assess the model's success in capturing both the cyclical dynamics of the labor market and more standard business cycle moments. To further evaluate the validity of the model, we estimate the stochastic processes for remittances and total factor productivity (TFP) and test the model's ability to predict the behavior of the Mexican economy during the global financial crisis and its aftermath.

The results from the model indicate that the interaction between remittances and self-employment distinctively shape the dynamic behavior of the labor market in a typical middle-income country, resulting in a better fit with the data relative to existing models. In particular, in the wake of remittance fluctuations, the model can generate countercyclical unemployment, self-employment, and entry into self-employment from unemployment, as shown in the data. The model also generates volatile unemployment without generating counterfactual cyclical dynamics in labor force participation and salaried employment, a countercyclical trade balance, and volatile output and investment. We also are able to account for one key counterintuitive empirical fact that the emerging literature on remittances has had difficulty explaining. Namely, countercyclical remittances that contribute to smoothing households' consumption over the business cycle, often can lead to sharper fluctuations in output and employment.<sup>4</sup> Importantly, we show that alternative models that abstract from remittances, self-employment or endogenous labor market participation decisions are inconsistent with the evidence and generate counterfactual labor market dynamics.

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<sup>4</sup>We discuss the related literature in the next section.

The intuition behind our main results can be summarized as follows. A countercyclical remittance inflow triggered by an adverse productivity shock to the economy relaxes the household's budget constraint and ameliorates the contraction in consumption. Consistent with the micro evidence, the positive income effect from remittances also reduces households' overall participation in the labor market. The contraction in labor supply moderates the decrease in wages in the salaried sector, forcing firms to adjust to the adverse shock by reducing hiring and capital usage more sharply on impact, with detrimental effects on employment and aggregate activity. Thus, total output initially contracts by more relative to an economy with acyclical remittances. However, countercyclical remittances constitute additional funds that can be used to finance the start-up costs of microenterprises at the onset of the recession. Coupled with the fall in capital usage in the salaried sector, which generates an expansion in the availability of capital for self-employment ventures, remittances bolster a larger expansion in self-employment relative to an economy with acyclical remittances. Over time, the microfirms start to operate and expand in number along with employment and investment demand. In sum, these developments contribute to deeper output recessions followed by faster rebounds—a typical fact in emerging economies and all within a context where the dynamic response of the labor market is consistent with the data.

Section 2 of this paper offers a description of the modeling strategy and a brief review of the literature and Section 3 presents the model and its parametrization. Section 4 shows the results, including second moments and an impulse response analysis. In Section 5, we evaluate the success of the model in matching the response of the Mexican economy during the 2008-2009 global financial crisis, and Section 6 concludes.

## 2 Modeling Approach and Literature Review

Our modeling approach consists in modifying a standard small open economy real business cycle model with a single tradable good along four fronts. First, we incorporate remittance inflows that directly affect the household's budget constraint. Second, we introduce frictional labor markets to allow for involuntary

unemployment. Third, we introduce endogenous and frictional entry into self-employment from unemployment to capture microenterprise development. As explained further below, we use capital search frictions to do so.<sup>5</sup> Fourth, we include an explicit labor force participation margin to study the influence of remittances on household participation and labor supply decisions.

The presence of capital constraints among small (new and existing) firms in many developing countries motivates frictional entry into self-employment. Recent empirical evidence has highlighted the relevance of input (trade) credit from larger firms as one of the most important sources of external financing for self-employment ventures and microenterprise development (Demirgüç-Kunt and Maksimovic, 2008; Kantis et al, 2002, Farazi, 2014). In turn, Bosch and Maloney (2008) and Mandelman and Montes-Rojas (2009) show that in developing countries, self-employment expands during recessions and that such expansion arises mainly from an increase in transitions from unemployment to self-employment. To generate factual self-employment dynamics over the business cycle that are simultaneously consistent with the external financing sources of the self-employment sector, we model endogenous and frictional self-employment following Finkelstein Shapiro (2014). Specifically, we extend his setup to an open economy context and also include migrant remittance inflows. In addition, we consider a labor force participation margin, which was not previously studied in this context.

Two sectors—the salaried and self-employment sectors—produce an identical good with two different technologies. Salaried firms use salaried labor and capital to produce. They accumulate capital and post vacancies to attract salaried workers. In addition, they decide how much capital the firm uses. The remaining, unused capital is supplied as input credit through frictional capital markets to individuals who wish to become self-employed and in charge of their own microenterprise (we use the terms small-scale entrepreneurship, self-employment, and own-account work interchangeably throughout the paper). To produce, each self-employed individual uses a single unit of matched capital from the salaried sector and

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<sup>5</sup>This modeling approach is needed to generate factual cyclical dynamics in self-employment in the presence of capital constraints, where the latter have been shown to be an important barrier for micro and small firms. The use of capital search frictions is also consistent with the relationship-based nature of input credit relationships between small and larger firms (Finkelstein Shapiro, 2014).

an inelastically supplied unit of his own labor. Thus, the measure of capital in self-employment is also the measure of self-employed individuals. Households decide on the measure of members looking for salaried employment or self-employment ventures. They also spend resources to find capital suppliers (salaried firms) for these microenterprises. These resources are a proxy for the startup costs of microenterprise development. Importantly, we allow households to freely allocate remittance income between various uses, including consumption, the financing of startup costs for self-employment ventures, and savings.

Our paper is related to the growing literature on worker remittances, which has largely centered on the microeconomic consequences of remittance inflows. These include the negative impact on individual labor supply and labor force participation (Acosta, 2006, and Hanson, 2005), the positive effects on poverty alleviation and human and physical capital investment – including the creation of microenterprises in recipient countries (Woodruff, 2001; Woodruff and Zenteno, 2007) – and more generally, the impact of these flows on the allocation of remittance income between saving, consumption, and investment at the individual level (Sirkeci et al, 2012). In addition, Funkhouser (1992) and Yang (2008) show that remittances can promote entrepreneurial activities by relaxing liquidity constraints. Amuedo-Dorantes and Pozo (2006) and Yang and Choi (2007) study the insurance role of remittances, highlighting the important function these flows play in smoothing households' consumption in response to adverse income shocks.

The macroeconomic literature on remittances has largely focused on exploring how cyclical movements in remittance income affect aggregate volatility and has not reached a consensus.<sup>6</sup> Some studies argue that remittances can smooth aggregate fluctuations in certain variables while exacerbating the business cycle. Durdu and Sayan (2010) focus on sudden stop episodes and find that remittances stabilize aggregate fluctuations in Mexico but act as an amplification mechanism in Turkey. Chami et al (2012) find that remittances tend to stabilize aggregate fluctuations and reduce volatility in the economy. Conversely, Magnusson-Bernard (2010) claims that remittances can increase macroeconomic volatility in

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<sup>6</sup>Related studies include Acosta et al. (2009), who study the Dutch-Disease effects of remittances, and Mandelman and Zlate (2013), who use Mexican data to document the cyclical joint behavior of remittances and migration flows.

recipient countries. Neagu and Schiff (2009) explore the role of remittances as automatic stabilizers and argue that countercyclical remittances may not necessarily be stabilizing. Jansen et al (2012) show that remittance shocks may lead to significantly different output responses depending on the persistence of these shocks. Interestingly, Chami et al (2007) offer one way to reconcile these conflicting findings in the literature: remittances can reduce the contraction in household consumption during a downturn, but the same flows can alter labor supply decisions in a way that increases aggregate volatility. In this sense, our results are in line with theirs. Our richer model provides an economic intuition for this mechanism that is consistent with the behavior of employment dynamics in the data. While the existing literature focuses on the cyclical behavior of economy-wide aggregate hours worked in frictionless labor markets, the extensive margin of employment, including involuntary unemployment and changes in the composition of employment between salaried work and self-employment, has been absent in discussions of the aggregate implications of remittance fluctuations.

### 3 The Model

#### 3.1 Households and Self-Employment

As is standard in general equilibrium labor search models, we assume a representative household with a large number of members. Household members perfectly insure each other against variation in idiosyncratic income as they pool their labor earnings. Individuals can be out of the labor force, searching for salaried employment, searching for self-employment opportunities, or working in either a self-employed situation or for an employer. The labor force is thus given by  $lfp_t = n_{S,t}^h + n_{SE,t}^h + s_{S,t} + s_{SE,t}$ , where  $n_{SE}^h$  and  $n_S^h$  are the measures of self-employed and salaried workers from the perspective of the household, and  $s_{SE,t}$  and  $s_{S,t}$  account for those searching for employment in any of these occupations. The total measure of unemployment is defined as  $s_t \equiv s_{SE,t} + s_{S,t}$ . In turn, total equilibrium employment is defined as  $n_t \equiv n_{SE,t} + n_{S,t}$ , where  $n_{SE}$  and  $n_S$  denote equilibrium self-employment and salaried employment, respectively. We normalize the total population to one, so that  $lfp_t$  is also the labor force participation



rate, and  $olf_t \equiv 1 - lfp_t$  corresponds to the population outside the labor force. The unemployment rate is defined as  $u_t \equiv \frac{s_{S,t} + s_{SE,t}}{lfp_t}$ .

The problem of the household is:

$$\max_{\{c_t, s_{SE,t}, s_{S,t}, n_{SE,t+1}^h, n_{S,t+1}^h, b_t^*\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[ u(c_t) - h(s_{S,t} + n_{S,t}^h) - g(s_{SE,t} + n_{SE,t}^h) \right], \quad (1)$$

subject to the budget constraint:

$$c_t + \kappa(s_{SE,t}) + R_{t-1}^* b_{t-1}^* = b_t^* + w_{S,t} n_{S,t}^h + (z_{SE,t} - r_{SE,t}) n_{SE,t}^h + \Pi_{S,t} + rem_t, \quad (2)$$

where the subutility function over consumption  $u(\cdot)$ , the subutility function over salaried labor force participation  $h(\cdot)$ , and the subutility function over self-employment labor force participation  $g(\cdot)$  satisfy  $u'(\cdot) > 0$ ,  $u''(\cdot) < 0$ ,  $h'(\cdot) > 0$ ,  $h''(\cdot) < 0$ ,  $g'(\cdot) > 0$ ,  $g''(\cdot) < 0$ .  $c_t$  is household consumption,  $w_{S,t}$  is the wage of salaried workers,  $b_t^*$  are holdings of foreign bonds, and  $R_t^* = R^* \Phi(b_t^* - b^*)$  is the gross interest rate, where  $\Phi(\cdot)$ ,  $\Phi'(\cdot) > 0$  is a standard portfolio adjustment cost needed to avoid non-stationarity in the stock of foreign liabilities.<sup>7</sup>  $\kappa(\cdot)$  captures the total resource cost of searching for capital suppliers, which may be interpreted as a startup cost for self-employment ventures with  $\kappa'(\cdot) > 0$  and  $\kappa''(\cdot) \geq 0$ . Each successful self-employed individual earns  $(z_{SE,t} - r_{SE,t})$ , where  $z_{SE,t}$  is a sectoral productivity shock and  $r_{SE,t}$  is the rental rate of capital for self-employed individuals.  $\Pi_{S,t}$  are lump-sum profits from households' ownership of salaried sector firms. Finally,  $rem_t$  represents the remittance income that households receive from emigrants residing abroad, which is taken as given by households.<sup>8</sup>

The perceived laws of motion for self- and salaried employment are:

$$n_{SE,t+1}^h = (1 - \rho^{SE})(n_{SE,t}^h + s_{SE,t} p(\theta_{SE,t})), \quad n_{S,t+1}^h = (1 - \rho^S)(n_{S,t}^h + s_{S,t} p(\theta_{S,t})), \quad (3)$$

<sup>7</sup>See Schmitt-Grohé and Uribe (2003) for details.

<sup>8</sup>Since most developing countries do not have national unemployment insurance schemes, we abstain from including this benefit in the budget constraint for simplicity.

where  $\rho^{SE}$  and  $\rho^S$  are the exogenous separation rates for self-employed and salaried workers, respectively. We define the probability of finding a capital supplier as  $p(\theta_{SE,t}) = \frac{m(s_{SE,t}, (1-\omega_t)k_{S,t})}{s_{SE,t}}$ , where  $m(s_{SE,t}, (1-\omega_t)k_{S,t})$  is a constant-returns-to-scale matching function that brings together the total measure of searchers looking for self-employment opportunities  $s_{SE,t}$  and the unused share  $(1-\omega_t)$  of capital  $k_{S,t}$  from salaried firms. Capital market tightness is  $\theta_{SE,t} = \frac{s_{SE,t}}{(1-\omega_t)k_{S,t}}$ . For simplicity, we assume that each self-employed individual uses only one unit of capital to produce after a match with a capital-supplying salaried firm takes place. An analogous matching function  $m(s_{S,t}, v_{S,t})$  combines searchers in the salaried sector  $s_{S,t}$  with salaried sector vacancies  $v_{S,t}$ . The job-finding probability for a salaried searcher is  $p(\theta_{S,t}) = \frac{m(s_{S,t}, v_{S,t})}{s_{S,t}}$ , and labor market tightness is defined as  $\theta_{S,t} = \frac{v_{S,t}}{s_{S,t}}$ . We assume that wages and rental rates for capital are determined via Nash bargaining. The value functions needed to characterize the optimal Nash wage and capital rental rate are defined further below.

**Optimality Conditions** The household's optimality conditions are characterized by a standard Euler equation:

$$u'(c_t) = \beta \mathbb{E}_t R_t^* u'(c_{t+1}), \quad (4)$$

and two participation decisions, one for salaried workers:<sup>9</sup>

$$\frac{\frac{h'_t}{u'(c_t)}}{p(\theta_{S,t})} = (1 - \rho^S) \mathbb{E}_t \left\{ \left( \frac{u'(c_{t+1})}{u'(c_t)} \right) \left( w_{S,t+1} - \frac{h'_{t+1}}{u'(c_{t+1})} + \frac{\frac{h'_{t+1}}{u'(c_{t+1})}}{p(\theta_{S,t+1})} \right) \right\}, \quad (5)$$

and one for self-employed individuals:

$$\frac{\frac{g'_t}{u'(c_t)} + \kappa'_t}{p(\theta_{SE,t})} = (1 - \rho^{SE}) \mathbb{E}_t \left\{ \left( \frac{u'(c_{t+1})}{u'(c_t)} \right) \left( z_{SE,t+1} - r_{SE,t+1} - \frac{g'_{t+1}}{u'(c_{t+1})} + \frac{\frac{g'_{t+1}}{u'(c_{t+1})} + \kappa'_{t+1}}{p(\theta_{SE,t+1})} \right) \right\}. \quad (6)$$

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<sup>9</sup>For notational simplicity, we denote the partial derivatives of the capital search cost, the disutility from salaried participation, and the disutility from self-employment participation by  $\kappa'_t$ ,  $h'_t$ , and  $g'_t$ , respectively.

The first participation decision equates the expected marginal cost of searching for a salaried job to the expected marginal benefit, where individuals take into account the disutility cost from searching. The second participation decision characterizes the decision to become self-employed. The left-hand side equates the expected marginal cost of searching for self-employment, which includes both the resource and utility costs of searching for a capital supplier, to the expected marginal benefit, given by individual self-employment earnings net of the disutility from labor force participation as well as the continuation value of the capital relationship.

### 3.2 Salaried Production

Salaried firms post vacancies,  $v_{S,t}$ , accumulate capital,  $k_{S,t}$ , choose the share of capital used in-house,  $\omega_t$ , and decide on the desired level of salaried employment,  $n_{S,t}^f$ . As explained above, the remaining unused share of accumulated capital,  $(1 - \omega_t)$ , which we label input credit, is rented to self-employed individuals through frictional capital markets. The salaried firms' maximization problem is:

$$\max_{\{v_{S,t}, n_{S,t+1}^f, k_{S,t+1}, \omega_t, n_{SE,t+1}^f\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \Xi_{t|0} \left\{ z_{S,t} f(n_{S,t}^f, \omega_t k_{S,t}) - w_{S,t} n_{S,t}^f - \psi_S v_{S,t} - i_t + r_{SE,t} n_{SE,t}^f - \frac{\varphi k_S}{2} \left( \frac{k_{S,t+1}}{k_{S,t}} - 1 \right)^2 k_{S,t} \right\}, \quad (7)$$

where  $\Xi_{t|0} = \beta(u'(c_t)/u'(c_0))$  is the household's stochastic discount factor,  $z_{S,t}$  is a sectoral productivity shock, and  $f(\cdot)$  is a standard constant-returns production function.  $\psi_S$  is the exogenous flow cost of posting vacancies,  $i_t$  is investment, and  $\frac{\varphi k_S}{2} \left( \frac{k_{S,t+1}}{k_{S,t}} - 1 \right)^2 k_{S,t}$  is a convex capital adjustment cost. The perceived laws of motion for salaried employment and self-employment are, respectively:

$$n_{S,t+1}^f = (1 - \rho^S) (n_{S,t}^f + q(\theta_{S,t}) v_{S,t}), \quad n_{SE,t+1}^f = (1 - \rho^{SE}) (n_{SE,t}^f + q(\theta_{SE,t}) (1 - \omega_t) k_{S,t}), \quad (8)$$

where  $q(\theta_{S,t}) = \frac{m(s_{S,t}, v_{S,t})}{v_{S,t}}$  is the job-filling probability for posted vacancies and  $q(\theta_{SE,t}) = \frac{m(s_{SE,t}, (1 - \omega_t) k_{S,t})}{(1 - \omega_t) k_{S,t}}$  is the probability of finding a self-employed individual for the unused capital.

Capital accumulation evolves as follows:

$$k_{S,t+1} = (1 - \delta) k_{S,t} + i_t + (\rho^{SE} - \delta) n_{SE,t}^f - (1 - \rho^{SE}) q(\theta_{SE,t}) (1 - \omega_t) k_{S,t}. \quad (9)$$

Note that the standard law of motion for capital incorporates two extra terms in its right-hand side. The first adds the (depreciated) capital that goes back to the salaried firm when capital relationships with self-employed firms end for exogenous reasons. The second subtracts successfully matched capital that new self-employment firms will use in the subsequent period when newly matched capital becomes productive.<sup>10</sup>

**Optimality Conditions** Combining first-order conditions yields a standard job creation condition:

$$\frac{\psi_S}{q(\theta_{S,t})} = (1 - \rho^S) \mathbb{E}_t \Xi_{t+1|t} \left\{ z_{S,t+1} f_{n_S}^f(n_{S,t+1}^f, \omega_{t+1} k_{S,t+1}) - w_{S,t+1} + \frac{\psi_S}{q(\theta_{S,t+1})} \right\}, \quad (10)$$

a standard capital Euler equation (with capital adjustment costs):

$$\left[ 1 + \varphi_{k_S} \left( \frac{k_{S,t+1}}{k_{S,t}} - 1 \right) \right] = \mathbb{E}_t \Xi_{t+1|t} \left\{ \begin{array}{l} z_{S,t+1} f_{k_S}(n_{S,t+1}^f, \omega_{t+1} k_{S,t+1}) + (1 - \delta) \\ - \frac{\varphi_{k_S}}{2} \left( \frac{k_{S,t+2}}{k_{S,t+1}} - 1 \right)^2 + \varphi_{k_S} \left( \frac{k_{S,t+2}}{k_{S,t+1}} - 1 \right) \frac{k_{S,t+2}}{k_{S,t+1}} \end{array} \right\}, \quad (11)$$

and a self-employment capital supply condition:

$$\begin{aligned} & \frac{z_{S,t} f_{k_S}(n_{S,t}^f, \omega_t k_{S,t}) + (1 - \rho^{SE}) q(\theta_{SE,t})}{q(\theta_{SE,t})} \\ &= (1 - \rho^{SE}) \mathbb{E}_t \Xi_{t+1|t} \left\{ r_{SE,t+1} + (\rho^{SE} - \delta) + \frac{z_{S,t+1} f_{k_S}(n_{S,t+1}^f, \omega_{t+1} k_{S,t+1}) + (1 - \rho^{SE}) q(\theta_{SE,t+1})}{q(\theta_{SE,t+1})} \right\}. \end{aligned} \quad (12)$$

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<sup>10</sup>Notice that new matches are also subject to the separation rate shock,  $\rho^{SE}$ , before they start to produce in the next period.

The job creation condition equates the expected marginal cost of posting a vacancy to the expected marginal benefit, where the latter is comprised of the marginal product of salaried labor net of wages plus the continuation value of the salaried employment relationship. The capital Euler equation similarly equates the marginal cost of accumulating a unit of capital to the marginal benefit of doing so. Finally, the capital supply condition equates the expected marginal cost of devoting an additional unit of capital to matching – given by the marginal product of capital in the salaried sector as well as a term that captures the fact that matched capital remains in the firm until it becomes productive during the next period – to the expected marginal benefit. The latter is given by the rental rate that the salaried firm would obtain next period, the net benefit of recovering a separated unit of capital from the self-employment sector next period, and the continuation value of the capital relationship.

### 3.3 Wage and Rental Rate Determination

To determine the Nash wage and capital rental rates, the values to the household of having a household member in salaried employment,  $W_{S,t}$ , and self-employment,  $W_{SE,t}$ , are:

$$W_{S,t} = w_{S,t} - \frac{h'_t}{u_{c,t}} + \mathbb{E}_t \Xi_{t+1|t} \left\{ (1 - \rho^S) W_{S,t+1} \right\}, \quad (13)$$

$$W_{SE,t} = z_{SE,t} - r_{SE,t} - \frac{g'_t}{u_{c,t}} + \mathbb{E}_t \Xi_{t+1|t} \left\{ (1 - \rho^{SE}) W_{SE,t+1} \right\}. \quad (14)$$

Similarly, the values to a salaried firm of having an additional salaried worker and an additional capital relationship with a self-employed individual are:

$$\mathbb{J}_{S,t} = z_{S,t} f_{n_S^f}(n_{S,t}^f, \omega_t k_{S,t}) - w_{S,t} + \mathbb{E}_t \Xi_{t+1|t} \left\{ (1 - \rho^S) \mathbb{J}_{S,t+1} \right\} \quad (15)$$

and

$$\mathbb{J}_{SE,t} = r_{SE,t} + (\rho^{SE} - \delta) + \mathbb{E}_t \Xi_{t+1|t} \left\{ (1 - \rho^{SE}) \mathbb{J}_{SE,t+1} \right\}. \quad (16)$$

We assume free entry such that the value of salaried vacancies is zero in equilibrium. Following the literature, the wage and the rental rate of capital used in self-employment are determined via Nash bargaining. Thus, the Nash bargaining problems for the wage and the rental rate can be expressed as:

$$\max_{w_{S,t}} \left\{ (W_{S,t})^{v_S} (\mathbb{J}_{S,t})^{1-v_S} \right\}, \quad \max_{r_{SE,t}} \left\{ (W_{SE,t})^{v_{SE}} (\mathbb{J}_{SE,t} - \mathbb{J}_{U,t})^{1-v_{SE}} \right\}, \quad (17)$$

where  $v_S$  and  $v_{SE}$  are the bargaining powers for salaried the and self-employed workers, respectively. The threat point for salaried firms in the negotiation of the rental rate is the value of idle capital,  $\mathbb{J}_{U,t} = (1 - \delta)$ . The first-order conditions yield implicit functions for the Nash wage and rental rate:

$$W_{S,t} = \frac{v_S}{1 - v_S} \mathbb{J}_{S,t}, \quad W_{SE,t} = \frac{v_{SE}}{1 - v_{SE}} (\mathbb{J}_{SE,t} - \mathbb{J}_{U,t}). \quad (18)$$

Using the value functions for salaried workers and self-employed individuals as well as the salaried firm's value functions of having an additional salaried worker and an additional capital relationship, the resulting Nash wage and capital rental rate are given by:

$$w_{S,t} = v_S z_{S,t} f_{n_S}(n_{S,t}, \omega_t k_{S,t}) + (1 - v_S) \frac{h'_t}{u_c(c_t)} \quad (19)$$

and

$$r_{SE,t} = (1 - v_{SE}) \left( z_{SE,t} - \frac{g'_t}{u_c(c_t)} \right) - v_{SE}(\rho^{SE} - \delta). \quad (20)$$

Intuitively, the Nash wage depends on a combination of the marginal product of salaried labor and the disutility cost from participating in the labor market. In particular, an increase in salaried searchers puts upward pressure on wages to partly offset the rise in the utility search cost. Similarly, the Nash capital rental rate increases with sectoral productivity and decreases with a rise in self-employment searchers to partly offset the rise in the utility search cost. In addition, a rise in the capital depreciation rate puts upward pressure on the rental rate to compensate firms for the fact that if a unit of capital is matched, it

remains idle within the firm until the match becomes productive next period.

### 3.4 Resource Constraint and Shock Processes

Total output is given by the sum of salaried output and output in self-employment,  $y_t = y_{S,t} + y_{SE,t}$ .<sup>11</sup>

The resource constraint of the economy is:

$$y_t = c_t + \kappa(s_{SE,t}) + \psi_S v_{S,t} + i_t + b_{t-1}^* R_{t-1}^* - b_t^* - rem_t + \frac{\varphi_{k_S}}{2} \left( \frac{k_{S,t+1}}{k_{S,t}} - 1 \right)^2 k_{S,t}, \quad (21)$$

The sectoral productivity shocks  $z_{S,t}$  and  $z_{SE,t}$  follow independent standard AR(1) processes:

$$\ln z_{S,t} = \rho_{z_S} \ln z_{S,t-1} + \varepsilon_t^{z_S}, \quad \ln z_{SE,t} = \rho_{z_{SE}} \ln z_{SE,t-1} + \varepsilon_t^{z_{SE}}, \quad (22)$$

where  $\varepsilon_t^{z_j} \sim N(0, \sigma_{z_j})$ ,  $j = S, SE$  and steady-state sectoral productivities are normalized to one.<sup>12</sup> We assume that remittances are driven by exogenous shocks while also responding to deviations of total output from steady-state. In particular, we assume that

$$rem_t = rem_{ss} \exp \left[ \eta_r \left( 1 - \frac{y_t}{y_{ss}} \right) \right] + \varepsilon_t^r, \quad (23)$$

where  $rem_{ss}$  and  $y_{ss}$  denote steady-state remittances and total output, respectively. Besides responding to output deviations, remittances also are affected by an exogenous i.i.d. component,  $\varepsilon_t^r \sim N(0, \sigma_r^2)$ . Also, note that  $\eta_r > (<) 0$  implies that remittances are countercyclical (procyclical), and  $\eta_r = 0$  implies that remittances are acyclical. The exogenous innovations may reflect developments in the country in which emigrants reside, which we take as given in our framework.

### 3.5 Competitive Equilibrium

<sup>11</sup>For an overview of the contribution of informality to aggregate economic activity as well as the different ways in which countries include estimates of self-employment into their national income accounts, see ILO (2013).

<sup>12</sup>Introducing steady-state productivity differentials (i.e., higher productivity in the salaried sector) does not change the main conclusions.

**Definition** (Competitive Equilibrium) Taking the set of exogenous processes  $\varepsilon_t^{i=\{z_S, z_{SE}, r\}}$  as given, the allocations  $\{c_t, n_{S,t}, n_{SE,t}, \theta_{S,t}, \theta_{SE,t}, k_{S,t}, \omega_t, s_{S,t}, lfp_t, y_t, b_t^*\}$  as well as prices  $\{w_{S,t}, r_{SE,t}\}$  satisfy the economy's resource constraint, the law of motion for salaried employment, the law of motion for self-employment, the salaried job creation condition, the self-employed individuals' participation decision, the salaried workers' participation decision, the capital Euler equation, the bond Euler equation, the salaried firms' capital supply condition, the definition of labor force participation, the Nash wage and capital rental rate equations, and the definition of total output.

### 3.6 Model Parametrization

We use Mexico as our benchmark economy since it has quality data on remittances and high-frequency labor flows (including self-employment), which we use to assess the empirical fit of the model. The time period is a quarter.

**Functional Forms** The salaried production function is Cobb-Douglas,  $y_{S,t} = z_{S,t} (n_{S,t})^{1-\alpha_S} (\omega_t k_{S,t})^{\alpha_S}$ ,  $0 < \alpha_S < 1$ . The disutility of salaried employment and self-employment are given by

$$h(n_{S,t} + s_{S,t}) = \varsigma \frac{(n_{S,t} + s_{S,t})^{\frac{1+\phi}{\phi}}}{\frac{1+\phi}{\phi}}, \quad g(n_{SE,t} + s_{SE,t}) = \varsigma \frac{(n_{SE,t} + s_{SE,t})^{\frac{1+\phi}{\phi}}}{\frac{1+\phi}{\phi}}, \quad (24)$$

where  $\varsigma, \phi > 0$ . We assume Cobb-Douglas matching in both the labor and capital markets so that  $m_{S,t} = M_S (s_{S,t})^{\xi_S} (v_{S,t})^{1-\xi_S}$  and  $m_{SE,t} = M_{SE} (s_{SE,t})^{\xi_{SE}} ((1-\omega_t) k_{S,t})^{1-\xi_{SE}}$ , where  $0 < \xi_S, \xi_{SE} < 1$ .  $M_S$  and  $M_{SE}$  are the matching efficiency parameters. Total capital search expenditures are  $\kappa(s_{SE,t}) = \psi_{SE} (s_{SE,t})^{\eta_{SE}}$  with  $\psi_{SE} > 0$  and  $\eta_{SE} \geq 1$ .

**Parameters from Literature** The capital share in salaried production,  $\alpha_S$ , is set to 0.32, the subjective discount factor,  $\beta$ , to 0.985, and the capital depreciation rate,  $\delta$ , to 0.025. The bargaining powers for salaried,  $v_S$ , and self-employed individuals,  $v_{SE}$ , and the associated matching elasticities,  $\xi_S, \xi_{SE}$ , are set to 0.5 (Hosios condition).<sup>13</sup> The adjustment cost of debt holdings,  $\Phi$ , is set to 0.05. This value is small

<sup>13</sup>The results remain qualitatively the same if we assume that salaried workers have a higher bargaining power than the self-employed.



enough to not affect the aggregate dynamics while guaranteeing debt stationarity. Using evidence from Bosch and Maloney (2008) for Mexico, the separation rates for salaried workers,  $\rho^S$ , and self-employed individuals,  $\rho^{SE}$ , are 0.06 and 0.02, respectively. We assume linear capital search costs (i.e.,  $\eta_{SE} = 1$ ).<sup>14</sup> The persistence of the sectoral productivity shocks,  $\rho_{z_j\{j=S,SE\}}$ , is set to 0.92.

**Calibrated Parameters** We calibrate the remaining parameters to match specific targets for Mexico. We set the matching efficiency parameter for salaried employment,  $M_S$ , to capture a quarterly job-finding probability of 0.90.<sup>15</sup> We set the corresponding matching efficiency parameter for self-employment,  $M_{SE}$ , to capture a self-employment share of 0.23. We choose the common search disutility parameter,  $\varsigma$ , to obtain a labor force participation rate of 0.60, as in the data. We set the salaried vacancy flow cost,  $\psi_S$ , to obtain a per-vacancy posting cost equal to 3.5 percent of quarterly wages (Levy, 2007). We fix the capital search cost parameter,  $\psi_{SE}$ , to obtain a cost of searching for capital suppliers equal to 3 months of wages, which is broadly in line with the estimated average startup costs of microenterprises in Mexico (McKenzie and Woodruff, 2006).<sup>16</sup> We set steady-state remittances to deliver a remittance-to-output ratio of 2.4 percent (Mandelman and Zlate, 2012). Finally, we jointly calibrate the sensitivity of remittances to output fluctuations,  $\eta_r$ , the capital adjustment cost parameter,  $\varphi_{k_S}$ , the labor supply elasticity,  $\phi$ , the standard deviation of the sectoral productivity shocks,  $\sigma_{z_S}$ ,  $\sigma_{z_{SE}}$ , and the standard deviation of the remittance shock,  $\sigma_r$ , to match the cyclical correlation between remittances and output (-0.38), the relative volatility of investment (2.78), the cyclical correlation between output and the population outside of the labor force (-0.157), the volatility of output (2.39), the persistence of output (0.846), and the cyclical correlation of output and the current-account-output ratio (-0.47).<sup>17</sup>

<sup>14</sup>The results do not change if we assume convex search costs.

<sup>15</sup>While this value is arguably higher than in the data, it yields a salaried employment share close to the one in the data (0.72) without allowing the job-finding rate to go above one. This target also implies that the steady-state unemployment rate is slightly higher than in the data. Importantly, the unemployment rate in the model is between the official unemployment rate of 5 percent and a value of 10.5 percent, which is consistent with a broader definition of unemployment used by Mexico's statistical agency, INEGI, that takes into account a measure of "partial employment." The steady-state transition rate for the self-employed is consistent with the evidence in Bosch and Maloney (2008). The results with a lower job-finding probability are broadly in line with those presented below. Finally, we note that recalibrating the model to bring the steady-state unemployment rate to exactly match a 5 percent rate implies that the volatility of unemployment becomes implausibly high.

<sup>16</sup>A much lower value—consistent with particular industries—does not change the main results.

<sup>17</sup>The resulting parameter values are:  $\{\eta_r, \varphi_{k_S}, \phi, \sigma_{z_S}, \sigma_{z_{SE}}, \sigma_r = 20, 3.3, 0.55, 0.138, 0.02, 0.032\}$ . The targets using output and investment are obtained using data for 1993Q1 through 2007Q4 from the FRED database. The cyclical correlations between out-

## 4 Results

### 4.1 Moments

Table 1 presents some selected business cycle statistics produced by the benchmark model with counter-cyclical remittances and compares them against the data.<sup>18</sup> The model performs remarkably well along several margins. It qualitatively captures the cyclicalities of aggregate employment, self-employment, unemployment, and entry into self-employment from unemployment in the data. The presence of a participation margin along with an explicit decision to enter self-employment makes this good empirical fit particularly noteworthy. This observation is important for two reasons. First, the inclusion of a participation margin in standard search models can yield counterfactual unemployment dynamics (Tüzemen, 2013). Second, the countercyclicalities of self-employment tends to put downward pressure on the cyclical correlation of the unemployment rate and makes the unemployment rate less countercyclical relative to a model with no countercyclical self-employment. Furthermore, the model is able to generate a relative volatility of the unemployment rate higher than one while preserving its intrinsic countercyclicalities, which can be challenging to obtain in standard search models (see Shimer, 2005, and Tüzemen, 2013, for a discussion). The most important shortcoming of the model lies in the relative volatility of consumption, which is well below its empirical counterpart. This result is in line with those in other studies (see, for example, Durdu and Sayan, 2010) and stems partly from the countercyclical nature of remittances. As previously discussed, many microeconomic studies show that countercyclical remittances serve as an insurance mechanism and ultimately smooth households' consumption over the business cycle. However, in our parsimonious model, we abstract from other channels that can potentially increase the volatility of consumption instead (e.g., financial frictions and trend growth shocks, among others).<sup>19</sup>

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put and remittances and output and the current-account-output ratio are from Durdu and Sayan (2008). The cyclical correlation of output with the population outside the labor force is from Bosch and Maloney (2008).

<sup>18</sup>We log-linearize the model around the non-stochastic steady-state and use a first-order approximation to the equilibrium conditions. The model is simulated for 2100 periods. We discard the first 100 periods and apply the Hodrick-Prescott (HP) filter with smoothing parameter 1600 to extract the cyclical component of the series and compute second moments.

<sup>19</sup>In addition, Restrepo-Echavarria (2014) shows that if the informal economy is poorly measured, the model can generate high volatility of measured consumption even though actual consumption is not nearly as volatile.

To highlight the importance of including both self-employment and labor force participation, we compare the benchmark model to three alternatives, shown in Table 1: (1) a model with no self-employment and no labor force participation margin, (2) a model with labor force participation margin but no self-employment, and (3) a model with self-employment but no labor force participation margin. These alternative specifications perform worse than the benchmark model. In particular, while the model with labor force participation and no self-employment does generate a relative volatility of unemployment higher than one, as in the data, it fails to generate countercyclical unemployment.<sup>20</sup> The versions of the benchmark model without a labor force participation margin generate substantially lower unemployment volatility, and more importantly, under the presence of remittance fluctuations, they generate procyclical unemployment. In contrast, the benchmark model is able to generate a cyclicity of unemployment, labor force participation, and self-employment which are consistent with the data. In addition, the benchmark model captures relatively well the cyclicity of aggregate employment and outperforms all the alternative specifications. Thus, the combination of self-employment and labor force participation is key for generating the correct cyclical behavior of unemployment. This is important to highlight since we do not need on-the-job search or other alternative mechanisms proposed in the existing literature to obtain a factual cyclical correlation for unemployment.

Countercyclical remittances that respond to output deviations also play a decisive role in the model's empirical fit. Table 2 compares the benchmark model to the same model under alternative calibrations: (1) remittance fluctuations are only determined by exogenous shocks,  $\eta_r = 0, \sigma_r > 0$ , and (2) remittances are constant,  $\eta_r = 0, \sigma_r = 0$ . As the results illustrate, assuming either stochastic remittances or constant remittances yields counterfactual correlations for aggregate employment, unemployment rate, labor force participation, and the current-account-output ratio.<sup>21</sup> For robustness, we also show that the results remain qualitatively identical if we assume that the parameters that determine the behavior of TFP and remit-

<sup>20</sup>Importantly, no reasonable values for the elasticity of labor supply can generate the cyclical correlation between output and the population out of the labor force in the data.

<sup>21</sup>We note that these alternative calibrations cannot capture the cyclicity of out-of-the-labor-force without running into convergence problems.

tances are estimated outside of the model (see Section 5 for more details).<sup>22</sup> A similar comment applies if we assume a higher share of steady-state remittances (10 percent of output versus 2.4 percent calibration) as observed in many other developing countries.<sup>23</sup>

## 4.2 Impulse Response Functions

**Negative Salaried Productivity Shock** Fig. 1 shows the impulse response functions to a negative shock to salaried productivity in the benchmark model with countercyclical remittances and an alternative scenario with acyclical remittances (i.e., no response of remittances to output fluctuations).<sup>24</sup> First consider the latter case where remittances do not respond to a contraction in output (refer to the solid-red line with markers). The decrease in sectoral productivity reduces salaried wages (not shown), which in turn leads to a fall in the value of salaried employment and hence a contraction in the measure of salaried searchers. Firms post fewer vacancies, leading to a reduction in hiring. As households' disposable income decreases, consumption demand falls. In this adverse scenario, the salaried firms' reduced hiring induces them to reduce their capital usage and decrease investment. Labor force participation increases despite the fall in salaried wages (and hence the incentive to look for salaried employment) mainly because of the growth of self-employment searchers.<sup>25</sup> Indeed, households are induced to search for employment to compensate for the fall in disposable income (enhanced by the lack of unemployment insurance). In other words, at the household level, the negative income effect dominates the substitution effect arising from lower salaried wages so that labor force participation increases. As the recession hits, the opportunity cost of sending individuals to search for self-employment opportunities decreases and household

<sup>22</sup>Specifically, for the calibration in Column 6 of Table 2, we regress HP-filtered log TFP on its lag, and regress HP-filtered log remittances on HP-filtered log real GDP. This yields the shock processes for TFP and remittances as well as the parameters that determine the persistence of TFP and the response of remittances to output movements. Naturally, this calibration assumes a single aggregate productivity shock since we do not have high-frequency series on sectoral TFP.

<sup>23</sup>Increasing the steady-state remittance-to-output ratio while keeping all other parameters constant keeps the employment shares constant, increases consumption, and reduces the labor force participation and total output in the stationary equilibrium. Finally, we can show that all these results hold when we assume that both the salaried and self-employment sectors are subject to the same productivity shocks. Results are available upon request.

<sup>24</sup>The model with  $\eta_r = 0$  and  $\sigma_{rem} > 0$  is not recalibrated. We simply take the benchmark model and shut down the effect of output deviations on remittance movements.

<sup>25</sup>Note that both salaried employment and self-employment are state variables, so the adjustment in labor force participation *in the period of the shock* comes from the change in the measure of searchers and not from the measure of salaried and self-employed workers.

devote more resources to searching for capital needed to send household members to self-employment. Self-employed individuals further benefit from cheaper input credit as the salaried firms' reallocation of capital towards self-employment (via a decrease in capital usage within the firm) puts downward pressure on self-employment capital rental rates (not shown). In sum, an expansion of self-employment in recessions serves as a cushion during a recession. The increase in self-employment searchers, however, more than offsets the fall in salaried searchers, which ultimately generates a rise in unemployment at the onset of the recession.

Countercyclical remittances play an important insurance role in our benchmark model (refer to the dashed-blue line). While these foreign transfers widen the trade deficit, they actually translate into a current account surplus since these financial inflows are categorized as a positive current transfer in the balance of payments.<sup>26</sup> Remittances relax the household's budget constraint, reducing the contraction in consumption that takes place at the onset of the downturn. They also allow for members to forego their participation in a labor market with lower salaried wages. The change is mainly due to a larger reduction in the measure of salaried searchers and stands in contrast to the case with acyclical remittances, where participation actually increases.<sup>27</sup> Indeed, the remarkable decrease in salaried searchers leads to a very brief decline in unemployment on impact.<sup>28</sup> The contraction in salaried labor supply, however, lessens the decrease in salaried wages, affecting the profitability of salaried firms that are forced to adjust to the negative productivity shock by reducing hiring (vacancy postings) more sharply. This ultimately leads to an increase in unemployment.<sup>29</sup>

This behavior of the salaried sector results in a deeper contraction of output on impact. As the shock subsides, however, the economy recovers more vigorously. The self-employment sector plays a decisive role in the recovery. Consistent with the evidence, remittances allow households to devote more resources

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<sup>26</sup>See Acosta et al. (2009) for details.

<sup>27</sup>Put differently, at the household level and for total labor force participation, the substitution effect dominates the income effect for salaried employment when remittances are countercyclical.

<sup>28</sup>This is consistent with existing search models that introduce a participation margin (see, for example, Tüzemen, 2013).

<sup>29</sup>The response of salaried vacancies is qualitatively similar to the response of salaried searchers, whereby salaried vacancies contract by more when remittances are countercyclical. We do not show the response of salaried vacancies for expositional purposes.

to finance their self-employment start-up outlays (i.e., the household search costs for capital suppliers). Countercyclical remittances also dampen the initial fall in investment. As the self-employment sector expands, salaried firms can rent out more of their existing capital stock to the self-employed. In addition, as labor force participation declines and more individuals select self-employment, firms substitute labor for capital. In summary, while countercyclical remittances cushion the fall in consumption and investment during downturns, they generate sharper fluctuations in total output and unemployment. Despite that self-employment does not have a large direct effect on macro aggregates, the inclusion of this employment state is crucial in capturing the cyclical dynamics of unemployment. This is in line with the results in Table 1. In essence, self-employment introduces a trade-off in the household's labor force participation decision that effectively limits the contraction in participation relative to an economy with no self-employment margin. This aligns the response of total labor force participation with the data, and coupled with the response of salaried vacancies, it shapes the response of unemployment to shocks in a way that is consistent with the evidence.

**Positive Remittance Shock** Fig. 2 shows the impulse response functions to a positive exogenous innovation to remittances that relaxes the household's budget constraint. As before, remittances inflows are partly used for household consumption and also are used to finance the start-up costs of self-employment. On impact, the household reallocates household members away from salaried search and toward self-employment search. Therefore salaried firms reduce their capital usage and reallocate resources from the salaried sector to the self-employment sector. Frictional unemployment temporarily increases as household members transition from one job to another. This also results in a transitory production disruption that leads to a temporary decrease in aggregate output. Noticeably, remittances foster salaried firms' investment expenditures. Two factors can rationalize this. First, households substituting salaried searchers for self-employment searchers puts upward pressure on wages, inducing firms to substitute labor for capital. Second, as micro-enterprises increase in number, the demand for capital suppliers also increases.

There is a long standing debate in the self-employment literature on whether “push” or “pull” fac-

tors better characterize this phenomenon.<sup>30</sup> This discussion is worth putting in the context of our model. In Fig. 1, we mentioned that in response to a negative productivity shock, firms posted fewer vacancies, lowered salaries, and reduced capital usage. Some household members were thus “pushed” into self-employment. Even though these new entrepreneurs had relatively low labor productivity, the poor prospects in the salaried sector and the lower capital rental rates in self-employment increased the incentive to become self-employed. In contrast, a “pull” factor describes the expansion in self-employment that arises from a positive remittance shock, as the increase in self-employment occurs in tandem with increasing salaried wages.

**Negative Self-Employment Productivity Shock** Fig. 3 compares the response of the economy to alternative productivity shock specifications. The thin-blue line depicts a negative salaried shock (as described in Fig. 1). The thick-red line depicts a negative productivity shock to the self-employment sector. The dashed line depicts an aggregate (symmetric) negative productivity shock affecting both sectors. It is worth noting that the impulse responses to an aggregate (symmetric) productivity shock are remarkably similar to the ones describing the response of a salaried sector productivity shock. This is because the salaried sector accounts for a majority of aggregate economic activity, so that the response of salaried output effectively drives total output. This also explains why productivity innovations in the self-employment sector have limited impact on macro aggregates. The self-employment sector, however, plays a non-negligible role in affecting labor market dynamics and significantly impacts households’ employment outcomes.<sup>31</sup>

The impact of a negative productivity shock to the self-employment sector is more distinctive. All else equal, this shock reduces the capital rental rate that salaried firms receive from capital relationships, which pushes salaried firms to reduce the supply of capital to the self-employment sector. The adverse shock also reduces the incentive to search for self-employment, which ultimately generates a contraction in self-

<sup>30</sup>See Mandelman and Montes-Rojas (2009), for a review of the literature.

<sup>31</sup>For more on the importance of the composition of employment for labor market and aggregate dynamics, see Finkelstein Shapiro (2014) and Epstein and Finkelstein Shapiro (2014).

employment and also in total labor force participation. Salaried firms, however, keep more of their capital in-house, which raises the productivity of salaried workers. This pushes firms to hire more workers and accumulate more capital and pushes households to reallocate searchers towards salaried employment. Due to these offsetting effects on sectoral employment groups, the response of aggregate output and consumption is negligible. In summary, these results are consistent with the existing evidence suggesting that the salaried sector accounts for most of aggregate economic activity, while microenterprises play a more relevant role on the employment margin (Busso, Fazio, and Levy, 2012; Busso, Madrigal, and Pagés, 2012).

## 5 The 2008-2009 Global Financial Crisis in Mexico

To provide additional evidence on the validity of our framework, we explore whether the model can capture the response of the Mexican economy in the aftermath of the global financial crisis of 2008-2009. Importantly, recall that the model is calibrated using data from 1995 to 2007. To see how the model performs after 2007 – both during and in the aftermath of the crisis – we first estimate an AR(1) process using HP-filtered Total Factor Productivity (TFP) for Mexico and then use the residuals from this regression as the TFP shocks that we feed the model. Similarly, the residuals obtained from regressing HP-filtered log remittances on HP-filtered log real GDP yield the remittance shocks that we use in the benchmark crisis simulations. We next simulate the model and compare the model’s predictions to actual macroeconomic data.<sup>32</sup>

Fig. 4 shows a sharp contraction in output, consumption and investment in the data following Lehman’s bankruptcy in September 2008 (refer to the dashed line). We also observe a spike in both unemployment (rate and levels) and remittances inflows. The model naturally mimics the dynamics of remittances and

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<sup>32</sup>Since we cannot obtain sectoral TFP series from the data, we only allow for a single aggregate productivity shock that affects both self-employed and salaried firms in the model. We follow Meza et al. (2014) and assume a Cobb-Douglas production function where aggregate TFP is defined as  $A = Y/(K^\alpha L^{1-\alpha})$ . The capital stock is constructed using the perpetual inventory method. Labor is the sum of all the personnel employed (including independent contractors), and output is value added, where gross and intermediate output are deflated using the manufacturing producer price index (PPI) and intermediate goods deflator, respectively. The industrial survey from the Mexican statistical agency INEGI, the *Encuesta Industrial Anual* (EIA), is the original data source. Due to data limitations, we only use data from the manufacturing sector in the computations.



TFP and is successful in capturing the overall behavior of output and investment during this period (refer to the solid line).<sup>33</sup> As discussed above, the model cannot capture the volatility of consumption. The labor force participation in the model is qualitatively consistent with the data (although not quite as volatile as shown in the data). More importantly, the model does remarkably well in capturing the behavior of unemployment after 2008. This is worth highlighting since our framework abstracted from endogenous separations and demand shocks (which can often play an important role in fitting the data properly).

To keep these results consistent with the simulation results above, in Fig. 4, the persistence of the autoregressive specification for both the TFP and remittance shocks as well as the sensitivity of remittances to output deviations are assumed to be the same ones that we calibrated in Section 3. As an additional robustness check, we also consider the same experiment but used estimated parameters for the TFP and remittance processes. These estimated values are directly obtained from the regressions used to extract the TFP and remittance residuals that feed the shock processes in our model setup as opposed to being calibrated to match particular second moments in the data. The outcome from this alternative experiment (Fig. 5) suggests very similar results from both methodologies. Overall, we find the model to be generally consistent with the response of the Mexican economy to the 2008-2009 global financial crisis.

## 6 Conclusion

Remittances and self-employment represent an important source of income for households in developing countries. Several microeconomic studies have highlighted the role of remittances in labor supply decisions, including participation in the labor market and more recently investment in microenterprise development. Other studies have documented the importance of self-employment in shaping the structure of labor markets in many developing countries as well as its distinct cyclical pattern relative to salaried employment. The macroeconomic literature on remittances has focused on the role of these flows in

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<sup>33</sup>The empirical counterparts in Fig. 5 are obtained from the Federal Reserve Bank of St. Louis FRED database for Mexico except for the labor force participation rate and TFP. The labor force participation rate is obtained from Mexico's National Survey on Occupation and Employment (ENOE).

either reducing or exacerbating aggregate fluctuations, reaching little consensus, but has paid little attention to employment decisions and the cyclical behavior of the labor market. In this paper, we attempt to bridge the gap between the micro evidence and the macroeconomic literature on remittances. We build a business cycle model with frictional capital and labor markets to analyze the implications of remittance fluctuations for labor market and aggregate dynamics. We offer a novel environment that incorporates frictional salaried employment, a participation margin, and endogenous and frictional entry into self-employment, all of which capture important margins at the micro level. Importantly, the model allows us to study the effects of remittance inflows on unemployment dynamics in a tractable way.

We show that the model captures various salient business cycle and labor market facts remarkably well, including the procyclicality of labor force participation and the countercyclicality of self-employment, entry into self-employment from unemployment, unemployment, and the current account. The model successfully generates higher unemployment volatility relative to standard search models while maintaining the countercyclical behavior of unemployment. We also find that, while countercyclical remittances limit the contraction in consumption after a downturn and initially reduce unemployment, they can also generate sharper output and unemployment fluctuations, which is consistent with the evidence. The participation margin, combined with the behavior of remittances and the response of self-employment, plays a key role in explaining the model's success in matching particular stylized facts about the business cycle while capturing the cyclical dynamics of the labor market. Importantly, the model is able to reconcile seemingly opposing views in the literature regarding the consumption smoothing role of remittances and the potentially adverse impact of these flows for aggregate volatility. We show that the model performs well in capturing the behavior of investment, output, participation, and unemployment in Mexico during the 2008-2009 global financial crisis. This suggests that this stylized model can be a suitable laboratory that successfully captures important margins highlighted in the micro literature on remittances and can be used to study the aggregate effects of remittance fluctuations in a more comprehensive environment.

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Table 1: Business Cycle Statistics. Data vs. Model

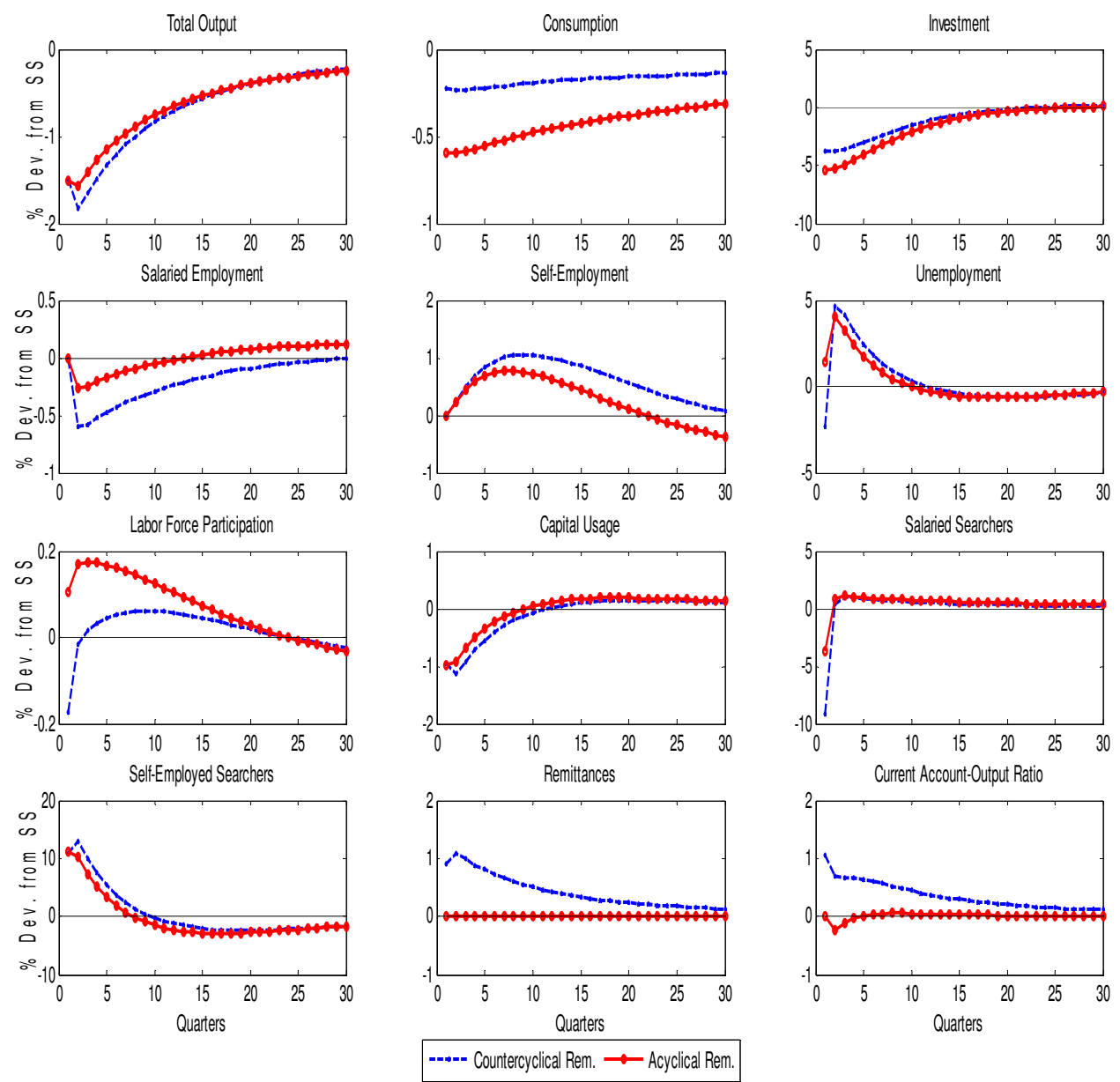
| Second Moments                | Data   | Benchmark Model | Benchmark Single Agg. TFP Shock | Model with no LFP, no SE | Model with LFP, no SE | Model with SE, no LFP |
|-------------------------------|--------|-----------------|---------------------------------|--------------------------|-----------------------|-----------------------|
| $\sigma_{y_t}$                | 2.39   | 2.39            | 2.39                            | 2.39                     | 2.39                  | 2.39                  |
| $\sigma_{c_t}/\sigma_{y_t}$   | 1.13   | 0.17            | 0.20                            | 0.27                     | 0.13                  | 0.585                 |
| $\sigma_{i_t}/\sigma_{y_t}$   | 2.78   | 2.79            | 2.79                            | 2.79                     | 2.79                  | 2.79                  |
| $\sigma_{u_t}/\sigma_{y_t}$   | 6.28   | 3.42            | 2.74                            | 0.447                    | 3.63                  | 0.799                 |
| $\rho(u_t, y_t)$              | -0.889 | -0.582          | -0.486                          | -0.731                   | 0.120                 | 0.221                 |
| $\rho(olf_t, y_t)$            | -0.157 | -0.154          | -0.158                          | -                        | -0.961                | -                     |
| $\rho(n_t, y_t)$              | 0.530  | 0.762           | 0.768                           | 0.995                    | 0.978                 | -0.221                |
| $\rho(n_{SE,t}, y_t)$         | -0.450 | -0.386          | -0.380                          | -                        | -                     | -0.433                |
| $\rho(p(\theta_{SE,t}), y_t)$ | -0.433 | -0.922          | -0.844                          | -                        | -                     | -0.945                |
| $\rho(y_t, y_{t-1})$          | 0.846  | 0.793           | 0.785                           | 0.739                    | 0.812                 | 0.574                 |
| $\rho(rem_t, y_t)$            | -0.380 | -0.480          | -0.390                          | -0.467                   | -0.498                | -0.365                |
| $\rho(ca_t/y_t, y_t)$         | -0.470 | -0.309          | -0.257                          | -0.350                   | -0.369                | -0.140                |

Table 2: Business Cycle moments under Alternative Remittance Parametrization

| Second Moments                | Data   | Benchmark Model | Stoch. Rem.<br>$\eta_r = 0,$<br>$\sigma_r > 0$ | Acycl. Rem.<br>$\eta_r = 0,$<br>$\sigma_r = 0$ | Estim. TFP, Rem. Param. | Higher Rem., 10 Percent of Output |
|-------------------------------|--------|-----------------|--|--|-------------------------|-----------------------------------|
| $\sigma_{y_t}$                | 2.39   | 2.39            | 2.39   | 2.39   | 2.06                    | 3.17                              |
| $\sigma_{c_t}/\sigma_{y_t}$   | 1.13   | 0.17            | 0.47   | 0.44   | 0.52                    | 0.13                              |
| $\sigma_{i_t}/\sigma_{y_t}$   | 2.78   | 2.79            | 2.79   | 2.78   | 2.78                    | 1.01                              |
| $\sigma_{u_t}/\sigma_{y_t}$   | 6.28   | 3.42            | 5.43   | 3.14   | 3.74                    | 5.68                              |
| $\rho(u_t, y_t)$              | -0.889 | -0.582          | 0.235  | 0.258  | -0.413                  | -0.254                            |
| $\rho(olf_t, y_t)$            | -0.157 | -0.154          | 0.021  | 0.100  | -0.158                  | -0.744                            |
| $\rho(n_t, y_t)$              | 0.530  | 0.762           | -0.179   | -0.238   | 0.535                   | 0.899                             |
| $\rho(n_{SE,t}, y_t)$         | -0.450 | -0.386          | -0.583   | -0.632   | -0.344                  | -0.327                            |
| $\rho(p(\theta_{SE,t}), y_t)$ | -0.433 | -0.922          | -0.112   | -0.716   | -0.761                  | -0.925                            |
| $\rho(y_t, y_{t-1})$          | 0.846  | 0.793           | 0.715  | 0.692  | 0.634                   | 0.83                              |
| $\rho(rem_t, y_t)$            | -0.380 | -0.480          | -0.019   | 0.033  | -0.157                  | -0.879                            |
| $\rho(ca_t/y_t, y_t)$         | -0.470 | -0.309          | 0.050  | 0.522  | -0.043                  | -0.734                            |

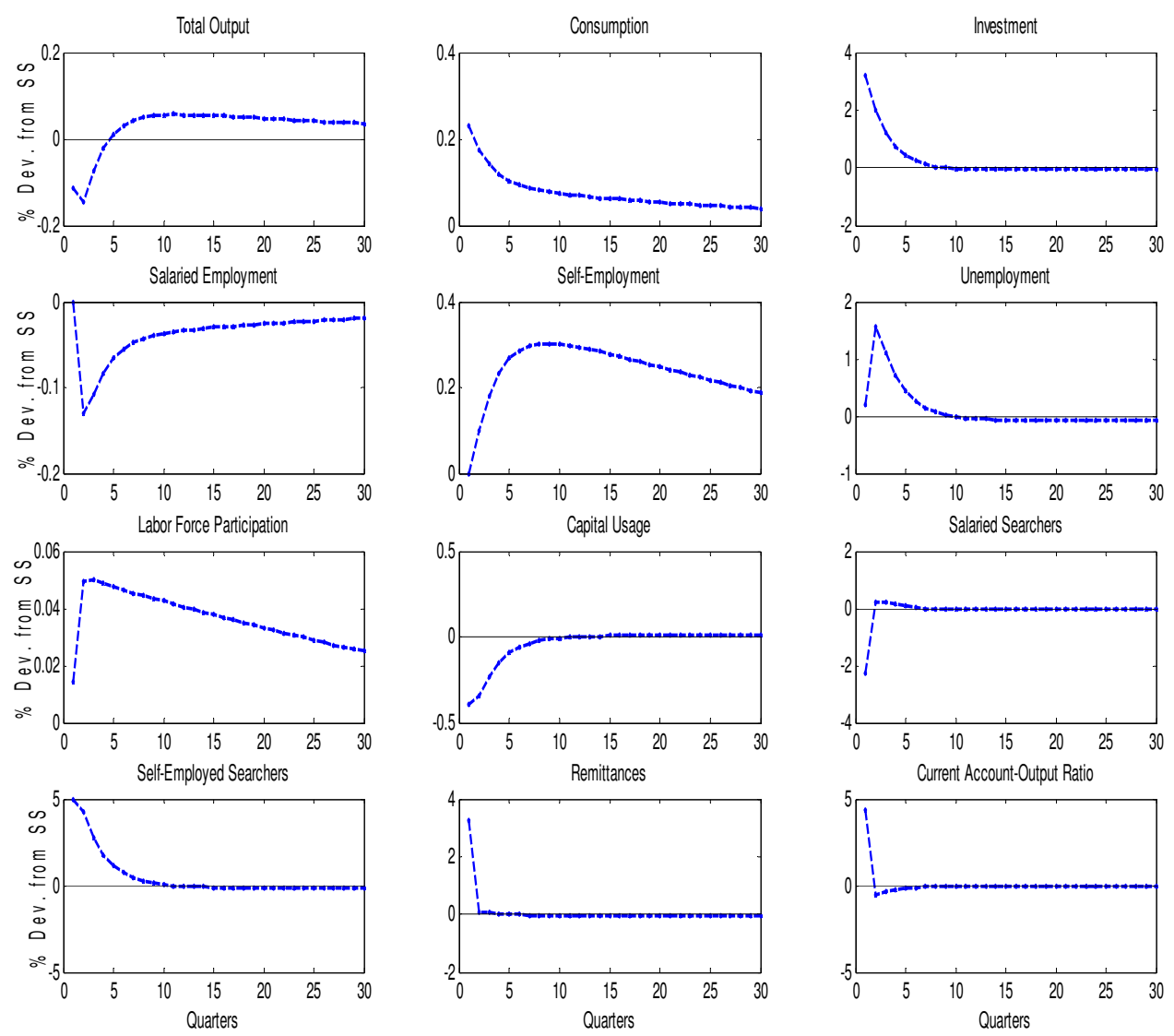


Figure 1. A Negative Productivity Shock in the Salaried Sector



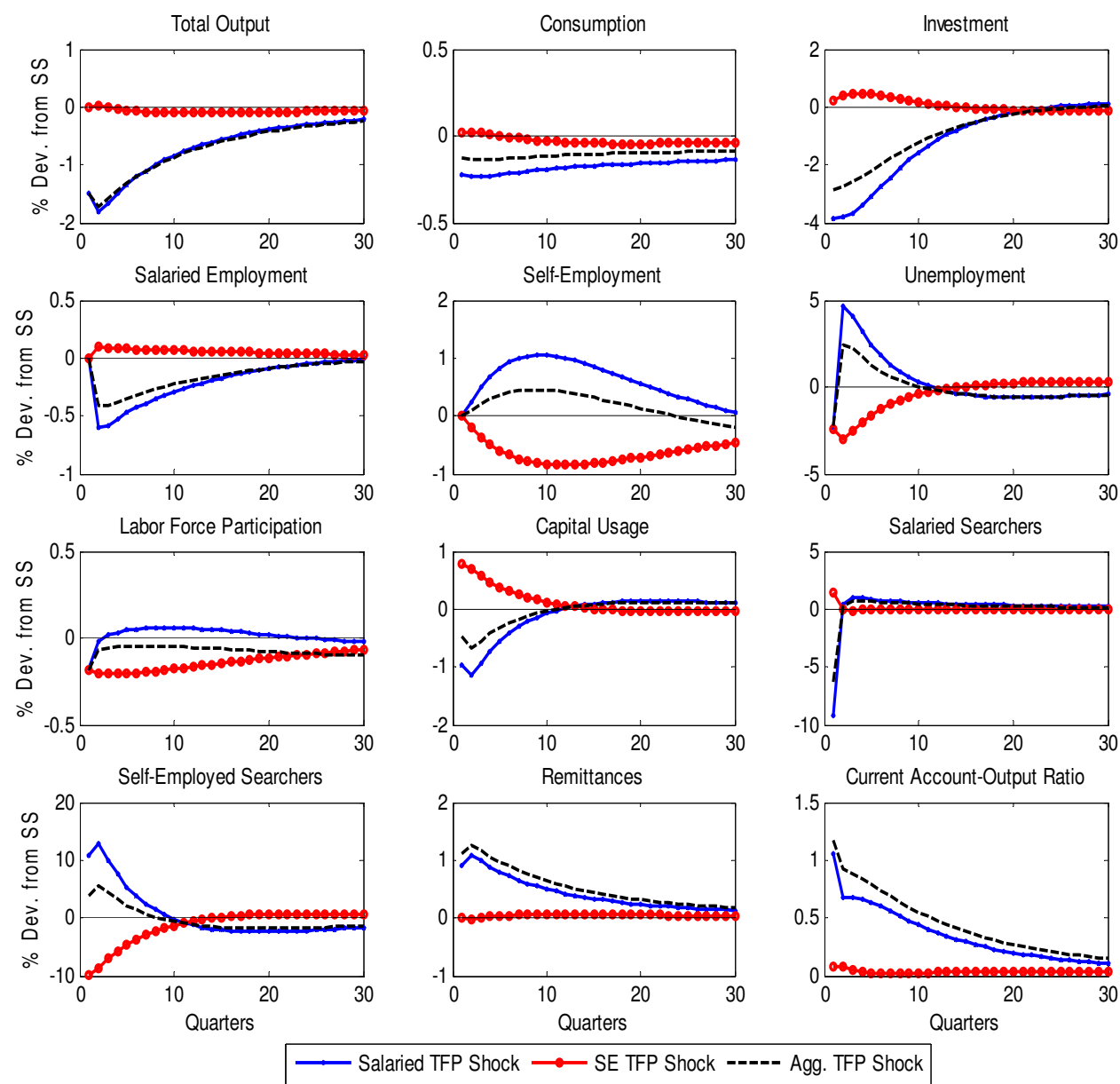
Note: Variables are expressed in percentage deviations from steady-state.

Figure 2. A Positive Shock to Remittances.



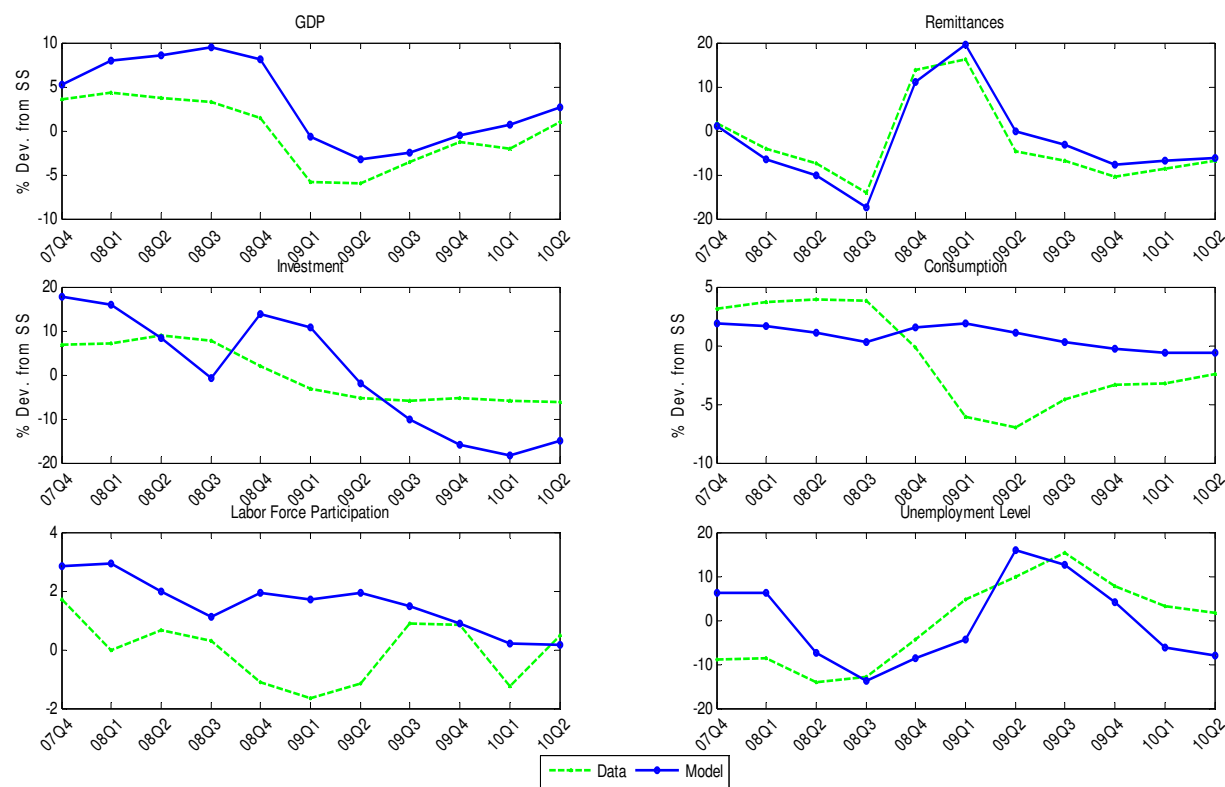
Note: Variables are expressed in percentage deviations from steady-state.

Figure 3. A Negative shock to Salaried Productivity, Self-employment Productivity and Aggregate productivity.



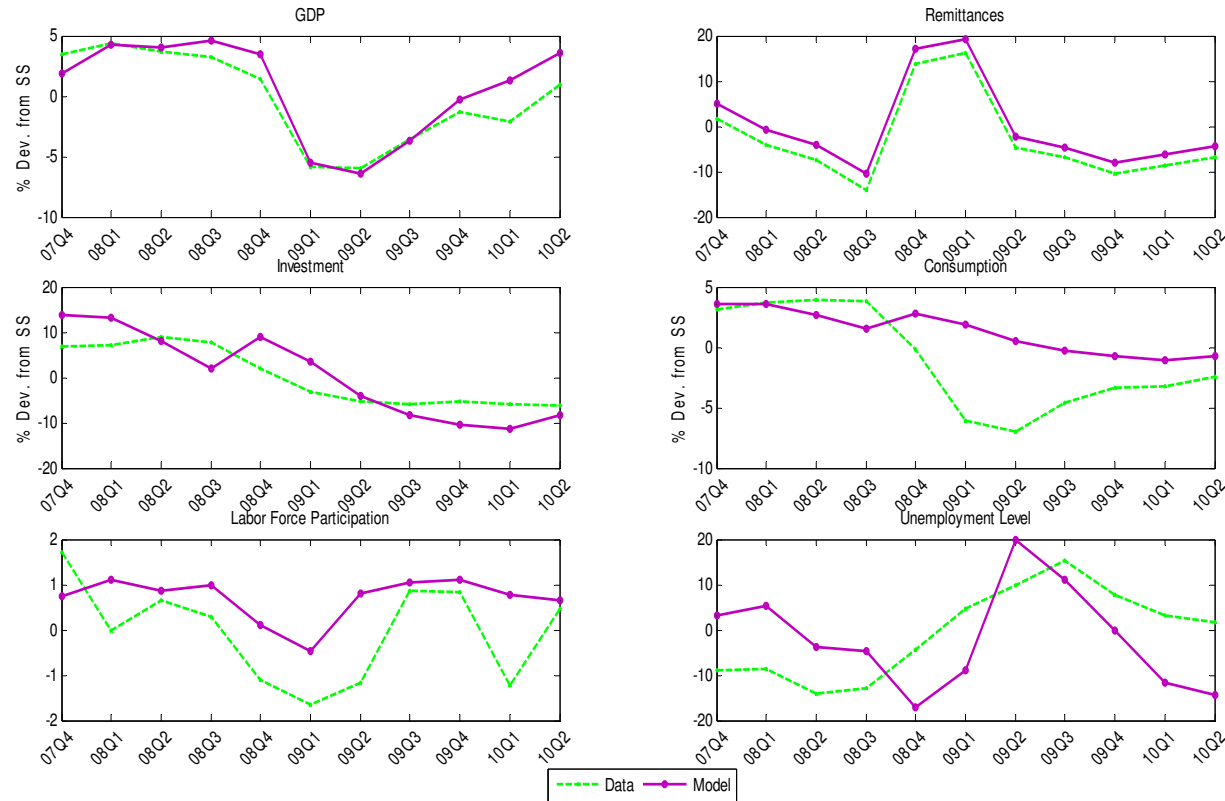
Note: Variables are expressed in percentage deviations from steady-state.

Figure 4. Data and Model Comparison: 2008-2009 Global Financial Crisis (Calibrated Parameters)



Note: See the manuscript for additional details.

Figure 5. Data and Model Comparison: 2008-2009 Global Financial Crisis (Estimated Parameters)



Note: See the manuscript for additional details.