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Macroprudential Policy and Labor Market Dynamics in Emerging Economies

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Macroprudential Policy and Labor Market Dynamics in Emerging Economies[1]

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Abstract

Emerging economies have high shares of self-employed individuals running owner-only firms who, in contrast to many salaried firms, have little access to formal financing and therefore rely on informal financing (input credit) from other firms. We build a small open economy real business cycle model with labor and financial market frictions where formal credit markets, informal credit, and the structure of the labor market interact. The model successfully replicates the cyclical behavior of sectoral employment, formal credit, and the main macroeconomic aggregates in emerging economies. We show that a countercyclical macroprudential policy that reduces formal credit fluctuations has positive though quantitatively limited effects on consumption and output volatility, but generates larger unemployment fluctuations in response to productivity shocks; the same policy increases labor market and aggregate volatility in response to net worth shocks. The link between input credit and the labor market structure---key for capturing the cyclical dynamics of labor and credit markets in the data---plays a crucial role for these results.

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I. INTRODUCTION

The 2007-2009 financial crisis highlighted the strong connection between financial markets, labor markets, and aggregate economic activity in developed countries. Understanding the consequences of financial market imperfections for labor markets and short-run economic activity is even more crucial in emerging economies as financial development continues to improve firms' access to formal (bank) financing. As Federico, Vuletin, and Végh (2014) recently documented, many of these economies have used countercyclical reserve requirements – a cyclical macroprudential policy – as a stabilization instrument to counteract the effects from adverse shocks to the economy. The use of macroprudential instruments over the business cycle has gained additional traction among emerging-economy policymakers in the aftermath of the global financial crisis (de la Torre, et al. 2012; Claessens and Ghosh, 2012; Jácome, Nier, and Imam, 2012; Claessens, Ghosh, and Mihet, 2013). However, little is known about the impact of these policies on labor market and aggregate dynamics, especially in environments where the structure of labor markets is deeply intertwined with both formal and informal credit markets, as is the case in many emerging economies.[1]

To explore the impact of a policy that reduces credit fluctuations over the business cycle – a countercyclical macroprudential policy – on labor market and aggregate dynamics in emerging economies, we draw on increasingly rich evidence on credit and labor market dynamics in Latin America and build a small open economy real business cycle model with financial and labor market frictions consistent with the employment and firm-financing structure of emerging economies. The model accounts for several important features of these economies. First, self-employment represents a larger share of total employment relative to advanced economies (Table 1; Perry et al., 2007; OECD, 2009). Second, the majority of the self-employed not only run owner-only firms, but also generally lack access to formal financing and therefore rely on (informal) input credit relationships with other firms to produce (IDB, 2005a,

[1] In this paper, informal credit (or financing) refers specifically to input credit (or in-kind credit, following Burkart and Ellingsen, 2004) between non-financial firms. This credit is informal because formal financial institutions (and the regulations associated with these institutions) do not *directly* affect input-credit relationships between firms. More generally, we consider informal financing as any financing that is not provided by commercial banks.

2005b). Third, only a segment of firms in the economy, mainly composed of salaried firms, has access to external financing from formal financial institutions (Global Financial Development Report, 2014) (see Section 2 for more details).

Our contributions are twofold. First, we show that the model can successfully capture salient facts about the cyclical behavior of interest rates, leverage, and the main macroeconomic aggregates in emerging economies recently documented in Fernández and Gulan (2014), along with the cyclical dynamics of salaried employment and self-employment – including most notably the countercyclicality of self-employment – in Bosch and Maloney (2008) and Fernández and Meza (2014). To the best of our knowledge, this is the first paper to jointly capture important features of credit and sectoral labor market dynamics in an emerging economy context. Importantly, a model that abstracts from the presence of input credit relationships between self-employed firms and salaried firms – that is, (informal) input credit for the self-employed – fails to generate the cyclical dynamics of consumption, interest rates, and self-employment in the data. Second, by introducing a countercyclical macroprudential policy that broadly embodies the effects of countercyclical reserve requirements, we show that this policy has positive (though quantitatively limited) effects on the volatility and persistence of consumption, investment, and output. However, this same policy generates sharper unemployment fluctuations in response to aggregate productivity shocks. The same policy leads to higher labor market and aggregate volatility in response to net worth shocks. The link between input credit and the labor market structure – a crucial element that is not only prevalent in emerging economies but is also needed to generate sectoral employment dynamics consistent with the data – is key for explaining these results. More generally, our findings highlight the importance of taking into account the interrelated structure between (formal and informal) credit and labor markets in the analysis of cyclical macroprudential policy in emerging economies.

In the model, salaried firms produce using workers and capital purchased with borrowed funds (formal external financing). These funds are subject to an external finance premium as a result of asymmetric information between borrowers and lenders (Bernanke, Gertler, and Gilchrist, 1999). In contrast to standard models, these salaried firms can also decide on the share of capital used in production; the remaining capital is available for matching with potential self-employed individuals, who do not have access to formal financing and require a capital match to transition from unemployment to self-employment. This establishes a direct link between (informal) input credit and an important segment of the labor market.

The intuition behind our findings is rooted in the effect of policy on the cyclical reallocation of resources between salaried firms with access to formal financing and self-employed firms that rely on input credit relationships. Specifically, in response to a negative productivity shock, a countercyclical macroprudential policy limits the rise in the cost of borrowed funds for salaried firms. The policy leads to a smaller contraction in salaried employment and investment, and also limits the fall in capital usage in the salaried sector relative to an economy without policy. Thus, the policy stabilizes economic activity in the salaried sector. However, the fact that salaried-sector capital usage falls by less under the policy implies a smaller availability of idle resources (input credit) for potential self-employed individuals. This reduces the countercyclicality of self-employment entry from unemployment and generates longer-lasting contractions in self-employment. The adverse response of self-employment more than counteracts the lower volatility in salaried employment and ultimately makes unemployment more responsive to shocks. A similar mechanism – operating through input credit – is at play when the economy is subject to net worth shocks in the salaried sector, so that the adverse impact of policy on unemployment dynamics does not depend on the type of shock.

The sharper fluctuations in unemployment under the policy do not translate into sharper fluctuations in consumption when we consider productivity shocks. This is the case since the policy reduces the volatility of salaried labor income, which more than offsets the rise in the volatility of self-employment income. However, the gains from lower consumption volatility are limited and tend to disappear once we consider the possibility of household heterogeneity. In sum, our findings emphasize an important link between a policy transmission channel – interfirm input credit – and the structure of labor markets that has received little attention in discussions of macroprudential policy in emerging economies. Our results also suggest that the aggregate gains from using a countercyclical macroprudential policy as a stabilization tool may be positive but limited under certain scenarios, and may generate additional labor market volatility. Thus, there may be a tradeoff between financial stability and employment volatility when the labor market structure is intertwined with informal and formal credit markets, but there may also be potential gains from combining cyclical macroprudential policies with targeted labor market interventions.

Our work is related to the literature on business cycles and financial frictions (Calstrom and Fuerst, 1997; Bernanke, Gertler, and Gilchrist, 1999, henceforth BGG), and to those studies that focus on small open economies (Gertler, Gilchrist, and Natalucci, 2007; Christiano, et al., 2011; and Fernández and Gulan, 2014, among others). Recently, variations of models with financial frictions have been used to study the consequences from macroprudential regulations.[2] Motivated by the recent global financial crisis, other studies have delved deeper into the interaction between labor and financial frictions in developed economies (Mumtaz and Zanetti, 2011; Zhang, 2012; Chugh, 2013). Our work makes two general contributions. The first is to provide insights into the interaction between financial imperfections and sectoral labor market dynamics in emerging economies, which has received little attention in existing studies.[3] The second contribution is to provide a first look at the aggregate effects of cyclical macroprudential policy with a focus on employment dynamics, a theme that has been absent in the literature on financial stability in emerging economies. Importantly, in contrast to existing work, the way credit and labor markets are linked in our model – key to generating business cycle dynamics consistent with the data – implies that credit policies can generate an important amplification effect in the labor market.[4]

[2]See Kiley and Sim (2012) for the U.S., Benigno et al. (2013), Unsal (2013), Medina and Roldós (2014) and Castillo, Carrera, Ortiz, and Vega (2014) for open economies, and González, Hamann, and Rodriguez (2013) for a commodity-exporting economy, among many others. Also, see Bianchi, Boz, and Mendoza (2012) and the references therein for a different set of models. For an empirical analysis of the efficacy of macroprudential policy, see Claessens, Ghosh, and Mihet (2013). For a review of the literature on macroprudential policy, see Angelini et al. (2012) and the references therein.

[3]Fernández and Herreño (2013) introduce frictional unemployment in a small open economy model with collateral constraints and explore unemployment dynamics around crisis episodes. However, they abstract from modeling different types of employment, including self-employment, as well as differences in financing sources across firms.

[4]For evidence on the role of trade credit as an amplification channel of sectoral shocks, see Raddatz (2010).

The paper is structured as follows. Section 2 provides a brief overview of existing evidence that broadly supports our modeling assumptions. Section 3 describes the model. Section 4 presents the calibration. Section 5 discusses the quantitative results. Section 6 concludes.

II. Evidence on Modeling Assumptions

The following facts motivate the structure of the model. First, while the share of self-employment in several developed economies is less than 10 percent, self-employment represents between 20 to 50 percent of total employment in many Latin American economies, with even larger self-employment shares in other emerging economies (Table 1; World Development Report, 2013). Also, in contrast to salaried employment, both self-employment and entry into self-employment from unemployment are countercyclical (Bosch and Maloney, 2008; Loayza and Rigolini, 2011; Fernández and Meza, 2014). Second, empirical evidence suggests that capital constraints and access to formal credit represent important obstacles for a majority of micro and small firms (Galindo and Schiantarelli, 2002; Global Financial Development Report, 2014). Indeed, most micro firms in emerging economies – many of which are owner-only – lack access to formal financing (Global Financial Development Report, 2014). As a consequence from limited access to formal financing, small firms must establish trade (informal) credit relationships with other firms (Tables 2 and 3).[5] This stands in contrast to larger salaried firms, which tend to use banks as one of their main sources of external financing (Global Financial Development Report, 2014).

The above facts imply that two types of financial structures are at play in emerging economies, one rooted in formal credit markets and the other in input credit linkages between non-financial firms. The first one is often characterized by asymmetric information problems that give rise to financial frictions, and is more prevalent among salaried firms that rely heavily on formal financing. The second one is characterized by a costly search process for input suppli-

[5] We use the terms trade credit, input credit, and informal credit interchangeably. A large number of self-employed and small firms also rely on household resources as well as friends and family to start their small-firm ventures (Demirgüç-Kunt and Maksimovic 2001; Chavis, Klapper, and Love, 2011). Chavis et al. (2011) document that 30 percent of firms between 1 and 2 years old in developing countries rely on trade credit, whereas 30 percent of firms of the same age rely on financing from other informal sources.

ers, and is more prevalent among self-employed and small firms with little access to formal financing. Importantly, the prevalence of input credit relationships among self-employed firms implies a direct link between informal credit markets and employment in these firms. Given the large shares of self-employment in total employment, fluctuations in informal credit have the potential to alter aggregate employment fluctuations.

In related work, the trade credit literature finds evidence of countercyclical supplier credit. For example, Love, Preve and Sarria-Allende (2007) document that larger firms (with better access to formal financial markets) increased the provision of supplier credit to other firms during the Mexican and East Asian crises. Klapper and Randall (2011) find that many firms either continued to extend trade credit or increased their supply of trade credit during the latest financial crisis in several countries. Moreover, the countries that suffered the greatest output falls among the country sample were the ones that saw the largest share of firms extending more trade credit during the crisis. Other studies have found that leasing and renting of capital – which requires establishing a relationship with the owner of capital – is countercyclical (Gal and Pinter, 2013). Recent work also points to evidence on the prevalence of nonfinancial firms that act as financial intermediaries in emerging economies (Shin and Zhao, 2013), as well as the role of interfirm linkages in propagating financial shocks (Kalemli-Ozcan et al., 2013). Our model is consistent with all these facts.

III. The Model

We modify a small-open-economy real business cycle model with a financial accelerator (see, for example, Fernández and Gulan, 2014) to introduce frictional labor markets and endogenous self-employment, following the labor market structure in Finkelstein Shapiro (2014).

There are four agents in the economy: salaried firms (or BGG entrepreneurs), households, matching firms, and capital producers. Capital producers are standard. A single tradable good is produced by two different sectors, one populated by salaried firms (BGG entrepreneurs) and the other by self-employed firms. Each sector uses a different production technology and different financing sources.

Salaried firms use salaried labor and capital to produce. They purchase salaried labor from matching firms in frictionless markets. Capital is obtained from capital producers using borrowed funds (formal credit). Following the literature, lenders face a costly verification problem such that salaried firms face an external finance premium on borrowed funds. In contrast to standard models, salaried firms also choose the fraction of purchased capital used in production within the firm. The remaining capital is purchased by matching firms in frictionless markets.

While salaried firms purchase salaried labor from matching firms in Walrasian markets, labor markets are still frictional. Matching firms post vacancies to attract salaried workers, where the latter are subsequently employed by salaried firms. Salaried matches between matching firms and households end with an exogenous probability. After purchasing capital from salaried firms, matching firms act as capital suppliers to potential self-employed individuals via frictional capital markets. We label this capital as input credit.[6]

Households spend resources to search for capital for self-employment ventures. Successful capital matches allow unemployed individuals to enter self-employment. These individuals remain self-employed until the input credit relationship with the matching firms ends, which occurs with an exogenous probability. Each self-employed individual uses a single unit of matched capital to produce.[7] Wages and capital rental rates are determined via Nash bargaining.

The BGG structure captures the presence of information asymmetries between lenders and borrowers, which gives rise to an external finance premium. If agency problems are important in formal credit contracts for larger firms, they are likely to be more prevalent among micro and small firms in emerging economies. Our trade credit structure abstracts from information asymmetries between the self-employed and input suppliers since existing literature suggests

[6]The inclusion of matching firms follows Zhang (2012) and is purely expositional: matching firms allow us to have a cleaner exposition of the model by separating the description of the BGG financial frictions from the labor and capital matching frictions in the salaried sector. An equally plausible alternative is to assume that capital producers directly supply capital to potential self-employed individuals via frictional capital markets. The allocations would be identical to those in the benchmark model.

[7]Thus, the measure of matched capital in the self-employment sector is also the measure of self-employed individuals in the economy.

that input credit can help reduce these information problems: suppliers may have better information about the sector where their customers operate, more effective enforcement mechanisms, and lower monitoring costs relative formal financial institutions (Burkart, Ellingsen, and Giannetti, 2011).

A. Households and Self-Employment Production

Following the literature, there is a representative household with a large number of family members and perfect risk-pooling across household members. We denote variables associated with the salaried sector with a subscript S and variables associated with the self-employment sector with a subscript SE. Households choose consumption c_t, the desired measure of self-employment $n_{SE,t+1}$, capital search expenditures $v_{SE,t}$, domestic debt d_t, and foreign debt b_t^* to maximize $E_0 \sum_{t=0}^{\infty} \beta^t u(c_t)$ subject to the budget constraint

$$\begin{aligned} & c_t + \kappa\left(v_{SE,t}\right) + T_t + (1-\phi_v)(1-\phi)V_{S,t} + R_{t-1}^* b_{t-1}^* + R_{t-1} d_{t-1} \\ = \quad & (z_{SE,t} - r_{SE,t}) n_{SE,t} + b_t^* + d_t + bu_t + w_{S,t} n_{S,t} + \Pi_{M,t}, \end{aligned}$$

and the household's perceived law of motion for self-employment[8]

$$n_{SE,t+1} = (1-\rho^{SE})(n_{SE,t} + v_{SE,t}\, p(\theta_{SE,t})).$$

The term $\kappa\left(v_{SE,t}\right)$ denotes total capital search expenditures, which we interpret broadly as the startup costs of self-employed firms. The government collects lump-sum taxes T_t. The amount $(1-\phi_v)(1-\phi)V_{S,t}$ (defined below) is spent by the household when salaried firms (BGG entrepreneurs) exit the market, which happens with probability $(1-\phi)$, and transfer a share $(1-\phi_v)$ of their net worth to the households, where $0 \leq \phi_v \leq 1$. The interest rate on foreign debt is given by $R_t^* = R^*\left[\Theta(b_t^* - b^*)\right]$ where $\Theta(b_t^* - b^*)$ is an adjustment cost function that induces stationarity in debt holdings (Schmitt-Grohé and Uribe, 2003) and b^* represents steady-state foreign debt holdings. The interest rate on domestic debt is R_t.

[8]We can introduce banks that receive deposits from households and borrow from abroad to provide credit to BGG entrepreneurs in the salaried sector. If the banking sector is competitive, we obtain the same allocations by abstracting from banks and allowing households to hold deposits and borrow from abroad. Regardless of the setup, the resources spent on costly-state verification are accounted for in the economy's resource constraint.

Total production by self-employed firms is given by $y_{SE,t} = z_{SE,t} n_{SE,t}$ where $z_{SE,t}$ is a sectoral productivity shock. Each self-employed individual pays $r_{SE,t}$ to rent capital in frictional markets (determined via Nash bargaining). Thus, individual self-employment earnings are given by $(z_{SE,t} - r_{SE,t})$. Households receive labor income $w_{S,t} n_{S,t}$ from workers in salaried firms and bu_t in unemployment benefits, where u_t is unemployment. Households own the matching firms, whose profits are $\Pi_{M,t}$. Note that, while households can hold debt, unemployed individuals still require matching with a capital supplier in order to move into self-employment and produce.[9] Capital relationships end with exogenous probability ρ^{SE} (the self-employment separation rate). $f(\theta_{SE,t})$ is the household's probability of finding a capital supplier, given by $f(\theta_{SE,t}) = m(k_{M,t}, v_{SE,t})/v_{SE,t}$, where $m(k_{M,t}, v_{SE,t})$ is a constant-returns-to-scale matching function that brings together household resources spent on capital search, $v_{SE,t}$, and capital from matching firms, $k_{M,t}$, and $\theta_{SE,t} \equiv v_{SE,t}/k_{M,t}$ is capital market tightness.

The solution to the household's problem yields an optimal decision to enter self-employment:

$$\frac{\kappa'\left(v_{SE,t}\right)}{f(\theta_{SE,t})} = (1-\rho^{SE})E_t\left\{\beta\frac{u_c(c_{t+1})}{u_c(c_t)}\left(z_{SE,t+1} - r_{SE,t+1} + \frac{\kappa'\left(v_{SE,t+1}\right)}{f(\theta_{SE,t+1})}\right)\right\}. \tag{1}$$

This condition equates the expected marginal cost of searching for capital to the expected marginal benefit of doing so. The latter is given by individual self-employment earnings if the match survives next period, $\left(z_{SE,t+1} - r_{SE,t+1}\right)$, as well as the continuation value from the capital relationship, $\kappa'\left(v_{SE,t+1}\right)/p(\theta_{SE,t+1})$ (Finkelstein Shapiro, 2014). We also obtain standard Euler equations for domestic and foreign debt: $u_c(c_t) = E_t\beta\left[R_t u_c(c_{t+1})\right]$ and $u_c(c_t) = E_t\beta\left[R_t^* u_c(c_{t+1})\right]$. For future reference, we define unemployment as $u_t = 1 - n_{S,t} - n_{SE,t}$ where $n_{S,t}$ and $n_{SE,t}$ denote the equilibrium measures of salaried employment and self-employment, respectively. Also, $\Xi_{t+1|t} = \beta u_c(c_{t+1})/u_c(c_t)$ is the household's stochastic discount factor.

[9] We can think of part of the debt as being used to finance a fraction of the start-up costs for self-employed firms (for example, the cost of reaching out to capital suppliers and establishing a relationship with them). However, these expenses do not guarantee that individuals will successfully find an input supplier, which is necessary to move into self-employment.

B. Salaried Production

Our description of salaried production follows closely the exposition of financial frictions in Gertler, Gilchrist, and Natalucci (2007) (or Gilchrist and Zakrajšek, 2011). For expositional purposes, we abstract from firm-specific indices.

Salaried firms (or BGG entrepreneurs) are risk neutral, discount profits at rate β, and produce using a constant-returns-to-scale production function that takes salaried labor $n_{S,t}$ and effective capital $\omega_{S,t}k_{S,t}$ as inputs, where $\omega_{S,t}$ is the fraction of capital $k_{S,t}$ used in salaried production (a choice).

Each salaried firm faces two shocks, a sectoral productivity shock $z_{S,t}$ and an idiosyncratic i.i.d. shock ζ_t, where $E[\zeta_t] = 1$. Based on the above, salaried output for a given firm is $y_{S,t} = \zeta_t z_{S,t} F(n_{S,t}, \omega_{S,t}k_{S,t})$ where $F(\cdot)$ is constant-returns-to-scale.

The timing of firms' decisions is as follows. At the end of period $t-1$, firms have chosen the stock of capital $k_{S,t}$ available for production in period t, where this choice is based on the expected return in $t-1$, $E_{t-1}R_{S,t}$ since the idiosyncratic shock in period t has not been realized yet. At the beginning of period t the shocks materialize and salaried firms maximize profits by making the following choices. They choose salaried labor demand $n_{S,t}$, which is purchased at price $p_{n,t}$ from matching firms in frictionless markets. Firms decide on the fraction $\omega_{S,t}$ of previously acquired capital $k_{S,t}$ that is used in production in the current period, while the remaining capital, $(1-\omega_{S,t})k_{S,t}$, is sold in frictionless markets to matching firms at price $p_{k,t}$.[10] Firms also purchase their desired stock of capital for next period, $k_{S,t+1}$, from capital producers at price $Q_{S,t}$. To make capital purchases, firms must borrow funds $b_{S,t+1}$, which are subject to an external finance premium. In particular, borrowed funds by the firm in $t+1$ are given by

$$b_{S,t+1} = Q_{S,t}k_{S,t+1} - nw_{S,t+1}.$$

[10]The timing of the choice over $\omega_{S,t}$ is identical to the timing of the choice over capacity utilization in Gertler, Gilchrist, and Natalucci (2007).

where $nw_{S,t+1}$ is the firm's net worth (defined below). Once production has taken place, firms can sell back the effective stock of capital that was used in production (net of depreciation) to capital producers and obtain $Q_{S,t}(1-\delta)\omega_{S,t}k_{S,t}$ in revenue.

The solution to the firm's problem yields an optimal decision to supply purchased capital to matching firms:[11]

$$p_{k,t} = z_{S,t}F_{\omega_S k_S,t}(n_{S,t},\omega_{S,t}k_{S,t}) + Q_{S,t}(1-\delta), \tag{2}$$

and an optimal demand for salaried employment:

$$p_{n,t} = z_{S,t}F_{n_S,t}(n_{S,t},\omega_{S,t}k_{S,t}), \tag{3}$$

so that the price of each unit of salaried labor purchased from matching firms is equal to the marginal product of salaried labor.[12]

Following Gertler, Gilchrist, and Natalucci (2007), we denote the ex-post gross return on capital by $R_{S,t}$ so that the marginal return to a unit of capital is characterized by:

$$E_t\left[R_{S,t+1}\right] \equiv \frac{E_t\left[z_{S,t+1}F_{\omega_S k_S,t+1}\omega_{S,t+1} + Q_{S,t+1}(1-\delta)\omega_{S,t+1} + p_{k,t+1}(1-\omega_{S,t+1})\right]}{Q_{S,t}}, \tag{4}$$

where the right-hand-side is the optimality condition with respect to $k_{S,t+1}$.

We can express the external finance premium as $s\left(Q_{S,t}k_{S,t+1}/nw_{S,t+1}\right) = \left(Q_{S,t}k_{S,t+1}/nw_{S,t+1}\right)^{\nu_S}$, where $\nu_S > 0$ is the elasticity of the external finance premium with respect to leverage, $(Q_S k_S/nw_S)$.[13]

[11] $f_{\omega_S k_S,t}$ is the partial derivative with respect to the second argument of the production function, which represents the actual capital used in production within the firm and not total capital. As in standard models, the marginal product of capital used within the firm is positive and decreasing.

[12] Importantly, recall that labor search frictions are present between the unemployed and the matching firms. The matching firms' supply of salaried workers to the salaried sector is frictionless (see Zhang, 2012). Given the presence of search frictions in the labor market, the wage for salaried workers will not be equal to the marginal product of salaried labor, as we show below.

[13] We can write the salaried firm's problem as in Bernanke, Gertler, and Gilchrist (1999) or Fernández and Gulan (2014) by specifying explicitly the cost of bankruptcy and the cutoff value of idiosyncratic productivity in the optimal contract. The inclusion of search frictions necessarily implies a more complicated framework. Thus, for the sake of transparency and given the well-known BGG setup, we adhere to the simplified exposition of the BGG framework in Gertler, Gilchrist, and Natalucci (2007) or Gilchrist and Zakrajšek (2011).

Net worth $nw_{S,t}$ evolves according to

$$nw_{S,t+1} = \phi V_{S,t} + \phi_v(1-\phi)V_{S,t},$$

where ϕ is the survival probability of salaried firms, and $V_{S,t}$ is defined as

$$V_{S,t} = z_{nw,t}\left(R_{S,t}Q_{S,t-1}k_{S,t} - \left[s\left(\frac{Q_{S,t-1}k_{S,t}}{nw_{S,t}}\right)R_{t-1}\right]b_{S,t} + p_{k,t}(1-\omega_{S,t})k_{S,t}\right).$$

In the expression above, $z_{nw,t}$ is an i.i.d. net worth shock and the term in brackets is the ex-post cost of borrowing funds to purchase capital (Gertler, Gilchrist, and Natalucci, 2007). The term $\phi_v(1-\phi)V_{S,t}$ in net worth represents the startup resources available for entering salaried firms, which are left behind by exiting firms. Also, in contrast to existing models with financial frictions, net worth in our model includes the return to selling capital purchased from capital producers to matching firms, $p_{k,t}(1-\omega_{S,t})k_{S,t}$.

With the above definitions in mind, the optimal demand for borrowed funds can be expressed as

$$E_t\left[R_{S,t+1}\right] = E_t\left[s\left(\frac{Q_{S,t}k_{S,t+1}}{nw_{S,t+1}}\right)R_t\right], \tag{5}$$

where the right-hand-side is the ex-post cost of borrowing and R_t is the gross domestic interest rate.

C. Matching Firms

Matching firms supply the capital they purchased from salaried firms to potential self-employed individuals via frictional capital markets. They also post vacancies to find salaried workers, who are then employed in salaried firms (Zhang, 2012). Specifically, matching firms choose salaried vacancies $v_{S,t}$, desired salaried employment $n_{S,t+1}$, capital demand $k_{M,t}$,, and desired self-employment capital supply $n_{SE,t+1}$ to

$$\max E_0 \sum_{t=0}^{\infty} \Xi_{t|0} \left\{ \begin{array}{c} p_{n,t}n_{S,t} - w_{S,t}n_{S,t} - \psi_S v_{S,t} \\ r_{SE,t}n_{SE,t} - p_{k,t}k_{M,t} + (\rho^{SE}-\delta)n_{SE,t} \\ +Q_{S,t}(1-\delta)k_{M,t} - (1-\rho^{SE})q(\theta_{SE,t})k_{M,t} \end{array} \right\},$$

subject to the perceived law of motion for self-employment capital (or self-employment)

$$n_{SE,t+1} = (1-\rho^{SE})(n_{SE,t} + k_{M,t}q(\theta_{SE,t})), \tag{6}$$

and the perceived law of motion for salaried employment

$$n_{S,t+1} = (1-\rho^{S})(n_{S,t} + v_{S,t}q(\theta_{S,t})). \tag{7}$$

Matching firms receive $p_{n,t}n_{S,t}$ from selling matched labor to salaried firms, pay $w_{S,t}n_{S,t}$ to matched salaried workers, and spend $\psi_S v_{S,t}$ on vacancy postings to attract salaried workers, where ψ_S is the fixed flow cost of posting a vacancy. They also receive $r_{SE,t}n_{SE,t}$ from renting matched capital to the self-employed, but spend $p_{k,t}k_{M,t}$ to purchase capital from salaried firms at price $p_{k,t}$. Capital from the self-employment sector separates at rate ρ^{SE} and returns to the matching firms, but matching firms have to cover the depreciation of capital for surviving relationships, δ. This is captured by the term $(\rho^{SE}-\delta)n_{SE,t}$. Finally, matching firms can resell purchased capital $k_{M,t}$ (net of depreciation) to capital producers at price $Q_{S,t}$, but a fraction $(1-\rho^{SE})q(\theta_{SE,t})$ of $k_{M,t}$ is matched and hence not available for resale.[14] $q(\theta_{SE,t})$ denotes the probability of matching with a household searching for capital, $q(\theta_{SE,t}) = m(k_{M,t}, v_{SE,t})/k_{M,t}$ (see Finkelstein Shapiro, 2014). Similarly, the probability of filling a salaried vacancy is $q(\theta_{S,t})$, where $q(\theta_{S,t}) = m(u_t, v_{S,t})/v_{S,t}$, $m(u_t, v_{S,t})$ is a matching function that brings together unemployed individuals u_t and salaried vacancies $v_{S,t}$, and $\theta_{S,t} \equiv v_{S,t}/u_t$ is labor market tightness.

This problem yields a standard job creation condition:

$$\frac{\psi_S}{q(\theta_{S,t})} = (1-\rho^{S})E_t\Xi_{t+1|t}\left\{p_{n,t+1} - w_{S,t+1} + \frac{\psi_S}{q(\theta_{S,t+1})}\right\}, \tag{8}$$

[14] Allowing matching firms to resell purchased capital to capital producers implies that the capital producers' problem is completely standard, as shown further below.

Assuming that matched capital is also evaluated using the price of capital, $Q_{S,t}$, does not change the main results of the paper.

and the optimal supply of capital to the self-employment sector:

$$\frac{p_{k,t} - Q_{S,t}(1-\delta) + (1-\rho^{SE})q(\theta_{SE,t})}{(1-\rho^{SE})q(\theta_{SE,t})} = \tag{9}$$

$$E_t \Xi_{t+1|t} \left\{ r_{SE,t+1} + (\rho^{SE} - \delta) + \frac{p_{k,t+1} - Q_{S,t+1}(1-\delta) + (1-\rho^{SE})q(\theta_{SE,t+1})}{q(\theta_{SE,t+1})} \right\}.$$

In the above expression, the matching firm equates the expected marginal cost of supplying capital to the expected marginal benefit of doing so. The expected marginal cost consists of three terms. The first one is the price at which matching firms buy capital from salaried firms. The second term represents one component of the opportunity cost of matching a unit of capital, given by the resale value if that unit is sold back to capital producers. The third term is a second component of the opportunity cost of matching a unit of capital, given by the value of an idle unit of matched capital that will become productive next period. All these terms are adjusted by the probability that a match materializes, $(1-\rho^{SE})q(\theta_{SE,t})$. The right-hand-side of the capital supply condition captures the expected marginal benefit, given by the rental rate on matched capital $r_{SE,t+1}$, the benefit of getting back any separated capital net of depreciation, $(\rho^{SE} - \delta)$, and the continuation value of maintaining a capital relationship next period.

Note that in equilibrium, the matching firm's demand for capital, $k_{M,t}$, is equal to the salaried firms' supply of capital, $(1-\omega_{S,t})k_{S,t}$, and $p_{k,t} - Q_{S,t}(1-\delta) = z_{S,t}F_{\omega_S k_S,t}$. This last fact implies that the optimal capital supply condition is identical to the one in Finkelstein Shapiro (2014).

D. Wage and Rental Rate Determination

We assume bilateral Nash bargaining for wages and the capital rental rate in self-employment. The wage and capital rental rate equations are identical to those in Finkelstein Shapiro (2014) and given by:[15]

$$w_{S,t} = \chi_S\left[z_{S,t}F_{n_{S,t}}(n_{S,t},\omega_{S,t}k_{S,t})+\psi_S\theta_{S,t}\right]+(1-\chi_S)b \tag{10}$$

$$+ \quad \frac{(1-\chi_S)\chi_{SE}}{1-\chi_{SE}}v^u_{SE,t}f(\theta_{SE,t})\left[\frac{z_{S,t}F_{\omega k_{S,t}}(n_{S,t},\omega_{S,t}k_{S,t})}{q(\theta_{SE,t})}\right]$$

$$+ \quad \frac{(1-\chi_S)\chi_{SE}}{1-\chi_{SE}}v^u_{SE,t}f(\theta_{SE,t})(1-\rho^{SE})\left[1-E_t\Xi_{t+1|t}(1-\delta)\right],$$

and

$$r_{SE,t} = (1-\chi_{SE})\left[z_t-\frac{\chi_S}{1-\chi_S}\psi_S\theta_{S,t}-b\right] \tag{11}$$

$$- \quad \chi_{SE}v^u_{SE,t}f(\theta_{SE,t})\left[\frac{z_{S,t}F_{\omega k_{S,t}}(n_{S,t},\omega_t k_{S,t})}{q(\theta_{SE,t})}\right]$$

$$+ \quad \chi_{SE}(1-v^u_{SE,t}f(\theta_{SE,t}))(1-\rho^{SE})\left[1-E_t\Xi_{t+1|t}(1-\delta)\right],$$

where $v^u_{SE,t} \equiv v_{SE,t}/u_t$, χ_S is the bargaining power of salaried workers, and χ_{SE} is the bargaining power of self-employed individuals. The intuition is straightforward: the Nash wage not only depends on the marginal product of salaried labor and salaried labor market conditions, but also on the likelihood of entering self-employment. The latter is embodied in capital market tightness (θ_{SE}). All else equal, higher capital market tightness implies a lower probability of entering self-employment, which in turn exerts downward pressure on salaried wages. Similarly, the capital rental rate is not only a function of labor market conditions in self-employment (embodied in capital market tightness), but also on salaried labor market conditions (embodied in salaried labor market tightness, θ_S). All else equal, higher salaried labor market tightness improves the self-employed's outside option and puts downward pressure on the capital rental rate.[16]

[15] See the Appendix for the value functions used to derive the wage and capital rental rate equations. For additional intuition behind these expressions.
[16] For more details regarding the intuition behind these expressions, see Finkelstein Shapiro (2014).

E. Capital Producers

Capital producers choose investment $i_{S,t}$ to

$$\max E_0 \sum_{t=0}^{\infty} \Xi_{t|0} \left[Q_{S,t} k_{S,t+1} - Q_{S,t}(1-\delta) k_{S,t} - i_{S,t} \right],$$

subject to the production technology for capital

$$k_{S,t+1} = (1-\delta) k_{S,t} + \Phi\left(\frac{i_{S,t}}{k_{S,t}}\right) k_{S,t}, \tag{12}$$

where $Q_{S,t}$ is the price that capital producers receive from selling capital to salaried sector firms and $\Phi\left(i_{S,t}/k_{S,t}\right)$ is an investment adjustment cost function. The first-order condition yields a standard expression for the price of capital:

$$Q_{S,t} = \left[\Phi'\left(\frac{i_{S,t}}{k_{S,t}}\right)\right]^{-1}. \tag{13}$$

F. Government, Market Clearing, and Definition of Total Output

The government collects lump-sum taxes from households to finance unemployment benefits and government spending, and its government budget constraint is $T_t = bu_t + g_t$. In turn, the economy's resource constraint is given by

$$\begin{aligned} y_t \quad = \quad & c_t + g_t + \kappa\left(v_{SE,t}\right) + \psi_S v_{S,t} + i_{S,t} + (1-\phi_v)(1-\phi) V_{S,t} - (\rho^{SE} - \delta) n_{SE,t} + b^*_{t-1} R^*_{t-1} \\ & - b^*_t + (1-\rho^{SE}) q(\theta_{SE,t})(1-\omega_{S,t}) k_{S,t} + \left[s\left(\frac{Q_{S,t-1} k_{S,t}}{nw_{S,t}}\right) - 1 \right] R_{t-1} b_{S,t-1}, \end{aligned} \tag{14}$$

where the last term on the right-hand side captures the bankruptcy costs of salaried firms. We define total output as $y_t = y_{S,t} + y_{SE,t}$.

IV. CALIBRATION

(a) Functional Forms and Stochastic Processes The production function in the salaried sector is given by $f(n_{S,t}, \omega_{S,t}k_{S,t}) = \left(\omega_{S,t}k_{S,t}\right)^{\alpha_S}(n_{S,t})^{1-\alpha_S}$, where $0 < \alpha_S < 1$. The instantaneous utility function is CRRA $u(c_t) = c_t^{1-\sigma}/(1-\sigma)$. Matching in both labor and capital markets is Cobb-Douglas, so that $m_S(u_t, v_{S,t}) = M_S u_t^{\xi} v_{S,t}^{1-\xi}$, $0 < \xi < 1$, where M_S is a matching efficiency parameter. Similarly, the matching function for capital is $m_{SE}(k_{M,t}, v_{SE,t}) = M_{SE}(k_{M,t})^{\xi}(v_{SE,t})^{1-\xi}$ where M_{SE} is a matching efficiency parameter. As a benchmark, we assume the same matching elasticity for both functions. The capital search cost is $\kappa(v_{SE,t}) = \psi_{SE}(v_{SE,t})^{\eta_{SE}}$ with $\psi_{SE} > 0$ and $\eta_{SE} \geq 1$. Following Schmitt-Grohé and Uribe (2003), we assume that the spread between foreign and domestic interest rates is $\Theta(b_t^* - b^*) = \eta_b \exp(b_t^* - b^*)$. The investment adjustment cost for capital producers is given by $\Phi\left(i_{S,t}/k_{S,t}\right) = i_{S,t}/k_{S,t} - (\varphi_k/2)\left(i_{S,t}/k_{S,t} - \delta\right)^2$. Sectoral productivity $z_{j,t}$ follows a standard AR(1) process: $\ln z_{j,t} = (1-\rho_{z_j})\ln z_j + \rho_{z_j}\ln z_{j,t-1} + \varepsilon_t^z$, $0 < \rho_{z_j} < 1$, where z_j represents steady-state sectoral productivity and $\varepsilon_t^z \overset{iid}{\sim} N(0, \sigma_z)$ is a productivity shock common to both sectors.[17] Following the literature, net worth shocks are i.i.d, so that $\ln z_{nw,t} = \varepsilon_t^{z_{nw}}$, and $\varepsilon_t^{z_{nw}} \overset{iid}{\sim} N(0, \sigma_{nw})$.

(b) Parameters from Literature We use Mexico as our benchmark economy since it has high quality data on labor flows. Table 4 presents standard parameters borrowed from existing literature. The time period is a quarter. The capital share in the salaried sector is 0.32. We interpret the contemporaneous value of unemployment purely as unemployment benefits, so $b = 0$. The subjective discount factor is 0.985. The depreciation rate of capital is 0.025. The salaried and self-employment separation rates are set to 0.05 and 0.02, respectively (Bosch and Maloney, 2008). We set the elasticity parameter in $\Theta(b_t^* - b)$, η_b, so that debt holdings converge back to steady state in a reasonable amount of time. The convexity of the capital search cost function, η_{SE}, is set to 1.1 (Krause and Lubik, 2010).[18] The bargaining power of both salaried and self-employed workers and the matching elasticity (common to both labor

[17] For robustness, we also consider the impact of sectoral shocks.
[18] The main results are robust to different degrees of convexity.

and capital markets) are set to 0.50.[19] The survival rate of BGG entrepreneurs in the standard BGG model for developed countries usually takes values above 0.97. Fernández and Gulan (2014) interpret the survival rate parameter in BGG as a dividend transferred to shareholders. Bartelsman, Haltiwanger, and Scarpetta (2004) document an exit rate of 7 percent for Mexican firms in the manufacturing sector. We set ϕ to 0.93. The steady-state foreign interest rate is set to 1.015, the CRRA parameter in the utility function is 2, and self-employment productivity is normalized to 1.

(c) Calibrated Parameters Table 5 shows the calibrated parameters and their respective targets. We calibrate the steady-state ratio of debt to total output to 30 percent and the ratio of government spending to total output to 10.2 percent (Aguiar and Gopinath, 2007). We set the matching efficiency parameters for the labor and capital matching functions to replicate the average shares of salaried employment and self-employment in Mexico from the National Survey on Urban Employment (ENEU). The elasticity of the external finance premium, v_S, is chosen to match the leverage ratio for non-financial firms in Mexico from Fernández and Gulan (2014). Following the literature, we set ϕ_v such that the net worth from exiting salaried firms that is not returned to households is equivalent to 1 percent of wages, a small number. The salaried sector vacancy posting cost is calibrated to represent 3.5 percent of wages (Levy, 2007). The capital search cost parameter ψ_{SE} is set to three months of wages, in line with the average startup costs of Mexican microenterprises (McKenzie and Woodruff, 2006).[20] Salaried productivity is chosen to capture the share of salaried output in total output in Mexico.[21] The second-moment targets used to calibrate the investment adjustment cost, the volatilities of the aggregate productivity and net worth shocks, and the persistence of the productivity processes, are the relative volatility of consumption and total investment, 1.13

[19]The results are robust to a smaller bargaining power for self-employed workers.

[20]The vacancy cost excludes the portion of hiring costs arising from regulations since the model merges formal and informal salaried workers into a single employment category. A higher hiring cost does not change the results. A similar claim holds for much lower values for ψ_{SE}.

[21]For this target, we consider available data on the share of output from informal enterprises, which includes most of the output from self-employment and excludes most of the output from informal workers in formal firms (see the data for Mexico for years 2003 through 2006 at http://wiego.org/informal-economy/statistical-picture).

and 2.78 respectively, the volatility of total output, 2.39, and the contemporaneous correlation between leverage and output, -0.30.[22]

V. Main Results

We first characterize the cyclical dynamics of the model in an environment without a countercyclical macroprudential policy and show that the model can successfully replicate various stylized facts about labor market and credit market dynamics. Then, we analyze how labor market and aggregate dynamics change when we introduce a countercyclical policy that reduces credit fluctuations over the business cycle.

A. Business Cycle Dynamics without Macroprudential Policy

Table 6 presents some basic business cycle statistics for the benchmark (no-policy) economy. The labor and credit market facts for Mexico are shared by other emerging economies (see Bosch and Maloney, 2008; Loayza and Rigolini, 2011; Fernández and Gulan, 2014).

First, a model with productivity shocks as the sole driver of business cycles (as in Fernández and Gulan, 2014) qualitatively replicates the countercyclicality of leverage, interest rates, the current account-output ratio, unemployment, self-employment, as well as the countercyclicality of the transition probability from unemployment into self-employment.[23] Moreover, the model generates high unemployment persistence. As shown in column 4 of Table 6, adding net worth shocks – the main specification – allows us to better capture the cyclicality of interest rates and does not alter the general dynamics of the labor market relative to the model

[22]We use data from 1993Q1 to 2007Q4 for Mexico, obtained from the Federal Reserve Bank of Saint Louis FRED database, for consumption, investment, and output. All series are logged (when applicable) and HP-filtered using a smoothing parameter of 1600. The target for the cyclicality of leverage is from Fernández and Gulan (2014). The equilibrium conditions are log-linearized around the model's steady state. We simulate the model for 2100 periods, remove the first 100 periods, apply the Hodrick-Prescott (HP) filter with smoothing parameter 1600 to the simulated series, and compute second moments as we would do with real data.

[23]Recall that in this case, the cyclicality of leverage is not a targeted moment. Table 7 in the Appendix shows the calibrated parameters for the model with only productivity shocks.

with only productivity shocks. Moreover, adding net worth shocks improves the model's ability to quantitatively capture the cyclical correlation between output and the transition from unemployment to self-employment, as well as the cyclical correlation between output and the current account-output ratio. However, the model does underestimate the volatility of interest rates and unemployment, where the latter is a well-known limitation of standard search models.

Despite the model's limited shortcomings, we can capture the behavior of the labor market, credit market, and standard macro variables surprisingly well. The key message to take from Table 6 is that the model is jointly consistent with the stylized facts about credit markets in Fernández and Gulan (2014) as well as important cyclical facts about emerging economy labor markets, including the countercyclicality of self-employment. This is one key contribution. More notably, comparing the benchmark model with a model with endogenous self-employment but no capital search frictions (i.e., no input credit channel) (column 5 of Table 6) shows that the latter model fails to deliver countercyclical self-employment, leverage, and interest rates, a relative volatility of consumption greater than one, a countercyclical current account-output ratio, and the persistence of unemployment in the data.[24] This gives additional validity to the search frictions and the inclusion of input credit in the benchmark model.

B. Business Cycle Dynamics with Macroprudential Policy

We follow Unsal (2013) and consider a policy that affects the external finance premium when credit to salaried firms deviates from trend. More specifically, we introduce a countercyclical regulatory Pigovian tax $\tau_{S,t}$ such that the return on capital $R_{S,t}$ becomes

$$R_{S,t} = \left[s\left(\frac{Q_{S,t-1}k_{S,t}}{nw_{S,t}}\right) R_{t-1}\right] \tau_{S,t}, \tag{15}$$

[24]Briefly, in this alternative version, we assume that households spend resources to send household members to self-employment, but they do not require a capital match in order to enter self-employment. However, each self-employed individual rents a single unit of firm-specific capital from salaried firms via frictionless capital markets. The only friction preventing individuals from instantaneously transitioning into self-employment is a timing assumption to be consistent with the timing in the benchmark model.

where $\tau_{S,t}$ responds to deviations in credit to salaried firms from steady state as dollows:

$$\tau_{S,t} = \exp\left[\eta_S\left(\frac{b_{S,t-1}}{b_S} - 1\right)\right]. \tag{16}$$

Above, $\eta_S \geq 0$ governs the intensity of macroprudential policy over the business cycle.[25] This policy generates a smaller (larger) spread between the domestic interest rate R and the cost of borrowed funds, R_S, during recessions (booms), which is similar to countercyclical reserve requirements on banks. To illustrate the role of policy in the model, we calibrate η_S such that the volatility of credit b_S is halved.

(d) Response to a Negative Aggregate Productivity Shock Figure 1 shows the response of the economy to a negative aggregate productivity shock under two scenarios: the benchmark economy ($\eta_S = 0$), and an economy with an active macroprudential policy that halves the volatility of credit ($\eta_S > 0$).

An active policy exerts downward pressure on the external finance premium during downturns (and upward pressure during expansions). After a negative productivity shock, total output and consumption are less persistent under the policy (the difference in total output dynamics relative to the economy without an active policy is small quantitatively; the effect of the policy on salaried output is somewhat larger than for total output). Investment exhibits a smaller contraction on impact and returns to trend earlier, and net worth is initially more resilient to the shock due to the smaller contraction in borrowed funds under an active policy.

The response of total output hides important compositional differences. Indeed, while the policy makes the fall in salaried output less persistent (which in part explains the behavior of total output), the contraction in self-employment output becomes substantially more persistent. To understand this result, we turn to the response of the labor market.

[25] We can also analyze the implications of a transaction tax on borrowed funds that, in contrast to our focus on policies that respond to the business cycle, would affect the steady state. This policy leads to a sharp increase in average self-employment and to a fall in consumption, investment, and output levels, even for very small tax rates on borrowed funds. This takes place because the policy generates a sharp reallocation of resources towards a sector with lower labor productivity.

By limiting the rise in the external finance premium, the policy reduces the size of the contraction in borrowed funds, which in turn limits the reduction in capital purchases by salaried firms. This pushes salaried firms to keep more of their purchased capital $k_{S,t}$ in-house relative to the no-policy case – that is, $\omega_{S,t}$ falls by less – as firms react to the fact that the contraction in available capital next period will be less severe under the policy. Thus, the effective amount of capital within the salaried sector, $\omega_{S,t}k_{S,t}$, contracts by less. This leads to a smaller fall in the marginal product of salaried labor, which bolsters salaried vacancy postings and leads to a smaller contraction in capital demand (and hence the price of capital) relative to the no-policy case. This explains the smaller contraction in salaried employment in the aftermath of the shock.

However, the fact that salaried firms decide to keep more of their capital within the sector implies that the reallocation of capital towards matching firms – and hence the available supply of capital to potential self-employed individuals – rises by less relative to an economy without policy.[26] In turn, this translates into a smaller expansion of self-employment after the shock. Importantly, as aggregate productivity returns to steady state, the initial increase in the availability of capital for the self-employed – which was already more limited under the policy – falls back to steady state earlier. This creates a long-lasting contraction in self-employment over time compared to the no-policy scenario.

In relative terms, the sharper contraction in self-employment in the aftermath of the shock more than offsets the smaller contraction and faster recovery in salaried employment. This explains the larger and more persistent rise in unemployment. Importantly, even though self-employment accounts for a smaller share of total employment relative to salaried employ-

[26]To understand the reallocation of capital to the self-employment sector after a negative productivity shock, recall that when salaried firms decide on ω_S, they are effectively evaluating the return from keeping one unit of capital – the marginal product of capital of the salaried firm, $z_{S,t}F_{\omega_S k_S}$ – to the return from matching that capital with the self-employed (and receiving the Nash capital rental rate r_{SE}). Importantly, r_{SE} not only depends on $z_{S,t}F_{\omega_S k_S}$, but also on labor market tightness (that is, salaried labor market conditions). During a downturn, salaried market tightness falls, which puts upward pressure on r_{SE}. This implies that while both r_{SE} and $z_{S,t}F_{\omega_S k_S}$ both contract, r_{SE} contracts by less, and this generates a reallocation of capital towards the self-employment sector. The reallocation of capital towards self-employment is also bolstered by the contraction in the price of capital $Q_{S,t}$, which contributes to the reduction in the expected marginal cost of supplying capital to the self-employed. All in all, there is an expansion of available capital for the self-employment sector, and this generates an increase in self-employment entry and self-employment (see Finkelstein Shapiro, 2014, for more).

ment, the former's dynamic response to the shock plays an important role in driving unemployment fluctuations.

(e) Response to a Negative Salaried-Firm Net Worth Shock Figure 2 shows the response of the economy to a negative shock to salaried-firm (BGG entrepreneur) net worth. First, consider the economy without policy. Given that $b_{S,t} = Q_{S,t}k_{S,t+1} - nw_{S,t+1}$, a negative net worth shock not only raises the desired amount of borrowed funds but also increases the external finance premium. In turn, the demand and the price of capital by salaried firms fall and generate a contraction in investment.

The fall in capital demand leads to a reduction in capital usage, $\omega_{S,t}$, salaried employment, and salaried output. This reduction in salaried-sector capital usage leads to a reallocation of available capital towards the self-employment sector, which generates an increase in entry into self-employment and in turn an expansion in the share of self-employment. The expansion in the self-employment sector more than offsets the contraction in salaried employment, so that unemployment initially falls in response to the shock. However, the fall in salaried output ultimately generates a contraction in consumption and total output as salaried output represents more than 70 percent of total output.

An active policy has the unintended effect of putting upward pressure on the external finance premium after a negative net worth shock. This limits the rise in desired borrowed funds by salaried firms and generates sharper contractions in salaried employment and output, investment, and total output. Moreover, this implies a larger reallocation of available capital towards the self-employment sector as salaried firms reduce capital usage by more under the policy. This leads to a larger expansion in self-employment and self-employment output after the shock, and ultimately explains the sharper movements in unemployment under the policy.

Given that the net worth shock only affects the salaried sector, the policy exacerbates the differences between the salaried and self-employment sectors, thereby leading to more pronounced fluctuations relative to the no-policy scenario. Note that in contrast to the response to productivity shocks, a stronger policy under net worth shocks delivers even larger fluctuations. Thus, while macroprudential policy generates sharper unemployment fluctuations regardless of the type of shock, the latter does matter for the effects of policy on other macro aggregates.

An important caveat regarding the response of the economy to net worth shocks: while a negative shock generates a fall in unemployment in the model, this is due to the fact that the efficiency of the search market for capital is not disrupted by the shock. If we assume that negative net worth shocks can worsen the efficiency of the matching process between available capital and potential self-employed individuals, the expansion in self-employment after a negative net worth shock would be more subdued and unemployment would end up increasing after the shock.[27] This is indeed the case when we allow capital matching efficiency to be positively correlated with exogenous innovations to net worth.

(f) Summary of Main Results and Key Mechanisms To summarize, policy interventions that limit credit fluctuations reduce the persistence of consumption and output contractions and decrease the volatility of investment in response to productivity shocks, while they amplify the response of all these variables in response to net worth shocks. However, the beneficial effects from a countercyclical macroprudential policy under productivity shocks are quantitatively small and more importantly, a countercyclical macroprudential policy tends to amplify unemployment fluctuations regardless of of the type of shock when we consider the linkages between formal credit, informal credit, and labor markets that are more prevalent in emerging economies. The link between salaried firms with access to formal financing and the self-employed via (informal) input credit markets plays a key role in explaining the adverse impact of cyclical macroprudential policy on unemployment dynamics. Indeed, the extent to which policy affects the use of resources in the salaried sector that are potentially avail-

[27] One way to rationalize the connection between net worth shocks and capital matching efficiency is as follows: salaried firms in financial distress may have a harder time convincing their customers (in our model, matching firms and ultimately the potential self-employed) of the quality of the firms' inputs, or they may face challenges in accessing secondary liquid markets to sell or rent their unused inputs. One way to capture this in a reduced-form way would be through a reduction in matching efficiency in capital markets triggered by a negative shock to net worth. A similar assumption regarding the connection between matching efficiency and productivity shocks can be made, but the incentive to supply capital to the self-employment sector ends up dominating, which would generate qualitatively similar results to those in the benchmark specification in response to productivity shocks.

able for the creation of self-employment ventures has direct implications for self-employment dynamics. Given the contribution of self-employment to total employment, changes in the cyclical behavior of self-employment due to policy can ultimately lead to important changes in unemployment fluctuations.

C. Additional Results and Robustness

(g) Shocks to Self-Employment Productivity In response to a negative productivity shock to the self-employment sector, the salaried sector's value of supplying capital to the self-employment sector falls. This reduces the supply of capital to the self-employed, raises salaried employment and output, and generates a reduction in self-employment and self-employment output. Thus, salaried and self-employment output co-vary negatively. The fact that salaried firms keep more of their capital reduces the need to invest. This leads to a contraction in the price of capital and, coupled with a fall in the supply of capital to the self-employment sector, to a fall in net worth and to an increase in the external finance premium. Introducing a countercyclical macroprudential policy increases the incentive to provide capital to the self-employment sector relative to the benchmark case with no policy, so that the drop in capital supply is smaller, leading to a smaller contraction in self-employment and output in the sector. The policy puts further downward pressure on the price of capital and leads to a larger contraction in investment. Ultimately, the larger drop in investment due to the policy limits the rise in salaried output (due to the rise in salaried employment), and the net result is higher total output volatility.[28] Despite this fact, the policy does reduce the variability of unemployment, which is explained by the smaller fall in self-employment when credit fluctuations are smaller.

(h) Shocks to Efficiency of Financial Intermediation We follow Gilchrist and Zakrajšek (2011) and consider a shock that increases the cost of external financing for a given lever-

[28]This takes place because, while salaried and self-employment output become less volatile, the covariance between output in the two sectors becomes less negative, which puts upward pressure on the volatility of total output.

age ratio.[29] An active macroprudential policy reduces the contraction in borrowed funds and leads to smaller reductions in salaried output, employment, investment, and consumption. The policy also reduces the reallocation of resources towards self-employment. Thus, similar to the case of aggregate productivity shocks, self-employment becomes less countercyclical and makes unemployment more volatile.

(i) Shocks to the Foreign Interest Rate Introducing foreign interest rate shocks hinders the model's ability to capture the cyclicality of the labor market in the data and generates counterfactual self-employment and salaried employment dynamics when these shocks are correlated with productivity shocks. Independent foreign interest rate shocks worsen the fit of the model relative to the benchmark calibration and also fail to generate the cyclicality of interest rates in the data. Importantly, this is the case because, as was the case in Fernández and Gulan (2014), the presence of financial frictions are sufficient to capture several features of emerging economy business cycles without resorting to foreign interest rate shocks.

(j) Household Heterogeneity We modify the benchmark model to introduce two different households and two types of salaried employment. The first household decides on domestic and foreign debt holdings, and receives income from both matching-firm profits and labor income solely from the first type of salaried workers. The second household receives income from the second type of salaried workers and self-employed individuals only.[30] The model is in line with the stylized facts captured by the benchmark model. However, a countercyclical macroprudential policy generates asymmetric effects on household consumption in response to productivity shocks, with one household enjoying lower consumption volatility and the other facing higher consumption volatility. These effects offset each other and the end result is that aggregate consumption volatility remains virtually unchanged relative to the no-policy scenario, so that the benefits from policy in terms of lower consumption volatility are less

[29]This shock can be interpreted as any shock that would affect the spread between the domestic interest rate and the lending rate.

[30]This captures the idea that only a segment of households in the economy can participate in formal credit markets, which is consistent with limited financial inclusion in many emerging economies.

clear. The main conclusions of the paper regarding the adverse impact of policy on unemployment dynamics remain the same.[31]

VI. Conclusion

The 2007-2009 financial crisis highlighted the strong connection between financial markets, labor markets, and aggregate economic activity and generated considerable interest in the role of macroprudential policy in both developed and emerging economies. Recent evidence shows that number of emerging economies have used countercyclical reserve requirements – a cyclical macroprudential policy – as a stabilization tool to counteract the effects from adverse shocks to the economy. However, little is known about the impact of such policies on labor market and aggregate dynamics, especially in environments where the structure of labor markets is deeply intertwined with both formal and informal credit markets, as is the case in many emerging economies.

To explore the impact of a countercyclical policy that reduces credit fluctuations on labor market and aggregate dynamics in emerging economies, we build a small open economy real business cycle model with financial and labor market frictions consistent with the employment and firm-financing structure of emerging economies. The model accounts for several crucial features of these economies, including the importance of self-employment in total employment, the role of informal input credit relationships in supporting self-employment, and the interaction between salaried firms with access to formal financing and self-employed firms without formal financing that takes place through interfirm input credit linkages. We show that the model successfully captures the cyclical dynamics of labor markets, leverage, interest rates, and the main macroeconomic aggregates in emerging economies, and highlight the importance of informal input credit in generating the cyclical patterns in both sectoral employment and formal credit in the data.

By introducing a countercyclical macroprudential policy that limits formal credit fluctuations among salaried firms, we show that in response to aggregate productivity shocks, cyclical pol-

[31] See Figure 3 in the Appendix for more details.

icy interventions have positive though limited effects on the volatility of consumption and output, with a stronger positive impact on investment and salaried-employment volatility. However, by reducing the salaried sector's incentive to establish input credit linkages with self-employed individuals over the business cycle, the policy reduces the countercyclicality of self-employment, which ultimately leads to sharper unemployment fluctuations. Importantly, the small gains in lower consumption volatility virtually disappear once we introduce household heterogeneity. In addition, the policy generates higher volatility in most macroeconomic aggregates, including unemployment, in response to net worth shocks. The connection between labor market dynamics, formal financial frictions, and macroprudential policy through (informal) input credit relationships plays a key role in explaining these results.

Given the presence of weak safety nets in most emerging economies, sharper movements in unemployment may have direct implications for welfare. Rather than downplaying the benefits of macroprudential policy as a stabilization tool, which could be stronger in other environments and in the presence of other shocks, we interpret our results as suggesting that policy complementarities, in particular between macroprudential regulation and active labor market interventions, may be worth exploring in discussions of cyclical macroprudential regulation in emerging economies.

Our work abstracted from a number of relevant issues. First, given the absence of models that analyze macroprudential policy and employment dynamics in tandem, we abstracted from monetary policy to give a more transparent overview of the impact of macroprudential policy on employment dynamics. However, it is possible that monetary policy may promote financial stability under certain circumstances, and it may interact with macroprudential regulations in such a way that unemployment fluctuations are reduced. Second, we focused on a particular policy that limits credit fluctuations. Given the large presence of self-employment in the nontradable sector, macroprudential policies specifically targeting capital flows and the tradable sector may yield different conclusions. We plan to explore these issues in future work.

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APPENDIX A. APPENDIX

A.1. Stylized Facts

Table 1. Distribution of Employment in Select Countries

Emerging Economies	Salaried Employment	Self-Employment	Developed Economies	Salaried Employment	Self-Employment
Argentina	74.7	25.3	Greece	71.4	28.6
Brazil	64.3	35.7	Italy	74.4	25.6
Chile	68	32.0	Canada	84.4	15.6
Colombia	50.7	49.3	Australia	84.7	15.3
Ecuador	50.7	49.3	United Kingdom	87.3	12.7
Mexico	70.7	29.3	Ireland	87.4	12.6
Paraguay	58.3	41.7	The Netherlands	88.7	11.3
Peru	68.7	31.3	Germany	88.4	11.6
Uruguay	80.5	19.5	Japan	88.8	11.2
Venezuela	59.7	40.3	Finland	89.1	10.9
Korea	72.0	28.0	Austria	90.5	9.5
Malaysia	82.2	17.8	Sweden	90.8	9.2
Philippines	67.6	32.4	France	91.4	8.6
Thailand	64.0	36.0	Denmark	92.1	7.9
Turkey	74.4	25.6	United States	92.5	7.5
South Africa	88.4	11.6	Norway	93.3	6.7

Source: OECD (2009). Notes: self-employment is expressed as a percent of non-agricultural employment and is an annual average using years 2000 through 2007.

Table 2. Consequences from Limited Access to External Formal Financing for Small Firms in Latin America

Consequences from Limited Access to Formal Financing	Percent of Entrepreneurs
Reduced Scale	56.0
Search for Partners	11.0
Search for Support from Suppliers or Customers	51.0
Delay in Launching Enterprise	32.0

Notes: The original source of the data is Table 6.5, IDB (2005b).

Table 3. Percent of Small Entrepreneurs Using Informal Financing in Latin America

Sources of Financing	Startup Year	Early Years
Financing from Suppliers	32.0	36.6
Financing via Purchase of Second-Hand Machinery and Equipment	27.5	20.6
Financing from Customers	18.0	19.1

Notes: The original source of the data is Table 6.2, IDB (2005b).

A.2. Value Functions, Nash Bargaining, and Model Equations

A.2.1. Value Functions and Nash Bargaining

The following expressions are used to derive the Nash wage and capital rental rates. The value of having a worker employed in the salaried sector is

$$\mathbf{W}_{S,t} = w_{S,t} + E_t \Xi_{t+1|t} \left\{ (1-\rho^S)\mathbf{W}_{S,t+1} + \rho^S \mathbf{W}_{U,t+1} \right\}.$$

The value of having an individual in self-employment is given by

$$\mathbf{W}_{SE,t} = (z_{SE,t} - r_{SE,t}) + E_t \Xi_{t+1|t} \left\{ (1-\rho^{SE})\mathbf{W}_{SE,t+1} + \rho^{SE} \mathbf{W}_{U,t+1} \right\}.$$

The value of having an individual in unemployment is

$$\mathbf{W}_{U,t} = b + E_t \Xi_{t+1|t} \left\{ \begin{array}{c} (1-\rho^S) f(\theta_{S,t}) \mathbf{W}_{S,t+1} + (1-\rho^{SE}) v^u_{SE,t} f(\theta_{SE,t}) \mathbf{W}_{SE,t+1} \\ \\ +[1-(1-\rho^S) f(\theta_{S,t}) - (1-\rho^{SE}) v^u_{SE,t} f(\theta_{SE,t})] \mathbf{W}_{U,t+1} \end{array} \right\}.$$

The value to the matching firm of having an additional matched salaried worker is:

$$\mathbf{J}_{S,t} = p_{n,t} - w_{S,t} + E_t \Xi_{t+1|t} \left\{ (1-\rho^S) \mathbf{J}_{S,t+1} \right\}.$$

Finally, the value to the matching firm of having a capital relationship with a self-employed individual is:

$$\mathbf{J}_{SE,t} = r_{SE,t} + (\rho^{SE} - \delta) + E_t \Xi_{t+1|t} \left\{ (1-\rho^{SE}) \mathbf{J}_{SE,t+1} \right\},$$

where we assume free entry throughout. The Nash bargaining problems for the wage and rental rate on capital, respectively, are given by

$$\max_{w_{S,t}} \left\{ \left(\mathbf{W}_{S,t} - \mathbf{W}_{U,t} \right)^{\chi_S} \left(\mathbf{J}_{S,t} \right)^{1-\chi_S} \right\},$$

$$\max_{r_{SE,t}} \left\{ \left(\mathbf{W}_{SE,t} - \mathbf{W}_{U,t} \right)^{\chi_{SE}} \left(\mathbf{J}_{SE,t} - \mathbf{J}_{u_k,t} \right)^{1-\chi_{SE}} \right\}.$$

where χ_S and χ_{SE} are the bargaining powers of salaried workers and self-employed individuals, respectively. As in Finkelstein Shapiro (2014), the value of unused firm-specific capital is

$J_{u_k,t} \equiv 1-\delta$. The first-order conditions of the Nash bargaining problems yield implicit equations for the wage and the capital rental rate.

A.2.2. Model Equations

The following equations characterize the competitive equilibrium:

$$n_{S,t+1} = (1-\rho^S)(n_{S,t} + v_{S,t} q(\theta_{S,t})), \tag{17}$$

$$\frac{\psi_S}{q(\theta_{S,t})} = (1-\rho^S) E_t \Xi_{t+1|t} \left\{ p_{n,t+1} - w_{S,t+1} + \frac{\psi_S}{q(\theta_{S,t+1})} \right\}, \tag{18}$$

$$\frac{\kappa'\left(v_{SE,t}\right)}{f(\theta_{SE,t})} = (1-\rho^{SE}) E_t \left\{ \beta \frac{u_c(c_{t+1})}{u_c(c_t)} \left(z_{SE,t+1} - r_{SE,t+1} + \frac{\kappa'\left(v_{SE,t+1}\right)}{f(\theta_{SE,t+1})} \right) \right\},$$

$$E_t\left[R_{S,t+1}\right] \equiv \frac{E_t\left[z_{S,t+1} F_{\omega_S k_S,t+1} \omega_{S,t+1} + Q_{S,t+1}(1-\delta)\omega_{S,t+1} + p_{k,t+1}(1-\omega_{S,t+1})\right]}{Q_{S,t}}, \tag{19}$$

$$k_{M,t} = (1-\omega_{S,t}) k_{S,t}, \tag{20}$$

$$n_{SE,t+1} = (1-\rho^{SE})(n_{SE,t} + k_{M,t} q(\theta_{SE,t})), \tag{21}$$

$$p_{k,t} = z_{S,t} F_{\omega_S k_S,t}(n_{S,t}, \omega_{S,t} k_{S,t}) + Q_{S,t}(1-\delta), \tag{22}$$

$$\frac{p_{k,t} - Q_{S,t}(1-\delta) + (1-\rho^{SE}) q(\theta_{SE,t})}{(1-\rho^{SE}) q(\theta_{SE,t})} = \tag{23}$$

$$E_t \Xi_{t+1|t} \left\{ r_{SE,t+1} + (\rho^{SE} - \delta) + \frac{p_{k,t+1} - Q_{S,t+1}(1-\delta) + (1-\rho^{SE}) q(\theta_{SE,t+1})}{q(\theta_{SE,t+1})} \right\},$$

$$b_{S,t} = Q_{S,t} k_{S,t+1} - n w_{S,t+1}, \tag{24}$$

$$p_{n,t} = z_{S,t} F_{n_S,t}(n_{S,t}, \omega_{S,t} k_{S,t}), \tag{25}$$

$$E_t\left[R_{S,t+1}\right] = E_t\left[s\left(\frac{Q_{S,t} k_{S,t+1}}{n w_{S,t+1}} \right) R_t \right], \tag{26}$$

$$\frac{\psi_S}{q(\theta_{S,t})} = (1-\rho^S) E_t \Xi_{t+1|t} \left\{ p_{n,t+1} - w_{S,t+1} + \frac{\psi_S}{q(\theta_{S,t+1})} \right\}, \tag{27}$$

$$w_{S,t} = \chi_S \left[z_{S,t} F_{n_{S,t}}(n_{S,t}, \omega_{S,t} k_{S,t}) + \psi_S \theta_{S,t} \right] + (1-\chi_S) b \tag{28}$$

$$+ \quad \frac{(1-\chi_S)\chi_{SE}}{1-\chi_{SE}} v^u_{SE,t} f(\theta_{SE,t}) \left[\frac{z_{S,t} F_{\omega k_S}(n_{S,t}, \omega_{S,t} k_{S,t})}{q(\theta_{SE,t})} \right]$$

$$+ \quad \frac{(1-\chi_S)\chi_{SE}}{1-\chi_{SE}} v^u_{SE,t} f(\theta_{SE,t})(1-\rho^{SE}) \left[1 - E_t \Xi_{t+1|t}(1-\delta) \right],$$

$$r_{SE,t} = (1-\chi_{SE}) \left[z_t - \frac{\chi_S}{1-\chi_S} \psi_S \theta_{S,t} - b \right] \tag{29}$$

$$- \quad \chi_{SE} v^u_{SE,t} f(\theta_{SE,t}) \left[\frac{z_{S,t} F_{\omega k_S}(n_{S,t}, \omega_t k_{S,t})}{q(\theta_{SE,t})} \right]$$

$$+ \quad \chi_{SE}(1 - v^u_{SE,t} f(\theta_{SE,t}))(1-\rho^{SE}) \left[1 - E_t \Xi_{t+1|t}(1-\delta) \right],$$

$$k_{S,t+1} = (1-\delta) k_{S,t} + \Phi\left(\frac{i_{S,t}}{k_{S,t}} \right) k_{S,t}, \tag{30}$$

$$Q_{S,t} = \left[\Phi'\left(\frac{i_{S,t}}{k_{S,t}} \right) \right]^{-1}, \tag{31}$$

$$u_c(c_t) = E_t \beta \left[R_t u_c(c_{t+1}) \right], \tag{32}$$

$$u_c(c_t) = E_t \beta \left[R^*_t u_c(c_{t+1}) \right], \tag{33}$$

$$y_t \quad = \quad c_t + \kappa\left(v_{SE,t}\right) + \psi_S v_{S,t} + (1-\phi_v)(1-\phi) V_{S,t} + i_{S,t} - (\rho^{SE} - \delta) n_{SE,t} + b^*_{t-1} R^*_{t-1} \tag{34}$$

$$-b^*_t + (1-\rho^{SE}) q(\theta_{SE,t})(1-\omega_{S,t}) k_{S,t} + \left[s\left(\frac{Q_{S,t-1} k_{S,t}}{n w_{S,t}} \right) - 1 \right] R_{t-1} b_{S,t-1}.$$

A.3. Calibration Details

Table 4. Parametrization for Benchmark Economy

Parameter	Value	Parameter Description	Parameter Source
α_S	0.32	Capital Share, Salaried Sector	DSGE Literature
b	0	Unemployment Insurance	No Unempl. Benefits
β	0.985	Discount Factor	DSGE Literature
δ	0.025	Capital Depreciation Rate	DSGE Literature
ρ^S	0.05	Salaried Separation Rate	Bosch, Maloney (2007)
ρ^{SE}	0.02	SE Separation Rate	Bosch, Maloney (2007)
η_b	0.050	Elasticity of Foreign Debt	See Text
η_{SE}	1.10	Curvature of Capital Search Cost	Krause and Lubik (2010)
χ_S	0.50	SE Bargaining Power	Search Literature
χ_{SE}	0.50	Salaried Bargaining Power	Search Literature
ξ	0.50	Matching Elasticity	Search Literature
ϕ	0.93	Survival Rate, BGG Salaried Firms	See Text
R^*	1.015	Foreign Interest Rate	DSGE Literature
σ	2	CRRA Utility Parameter	DSGE Literature
z_{SE}	1	Self-Employment Productivity	Normalization

Table 5. Calibrated Parameters

Parameter	Value	Parameter Description	Target in the Data
b^*	0.950	Steady State Foreign Debt	$b^*/4y = 0.30$
g	0.081	Steady State Gov. Spending	$g/y = 0.102$
M_S	0.154	Sal. Match. Efficiency	$n_S = 0.72$
M_{SE}	0.081	SE Match. Efficiency	$n_{SE} = 0.23$
χ_S	0.070	EFP Elasticity	Leverage Ratio of 1.73
ϕ_v	0.050	Fraction of nw_S, Exiting Firms	1 percent of wages
ψ_S	0.020	Salaried Vacancy Cost	3.5 percent of wages
ψ_{SE}	0.573	Project Posting Cost	3 months of wages
z_S	0.600	Steady State Salaried Prod.	$y_S/y = 0.827$
ρ_z	0.970	Autocorrelation of z	See Text
σ_z	0.017	Standard Dev. of z	See Text
$\sigma_{z_{nw}}$	0.013	Standard Dev. of z_{nw}	See Text
φ_k	9.900	Investment Adjustment Cost	See Text

A.4. Main Results

Table 6. Business Cycle Statistics: Data vs. Model

Targeted Moments	Data	Model with z Shocks	Model with z and z_{nw} Shocks	Endogenous SE, No Capital Search
σ_y	2.39	2.39	2.39	2.39
σ_c/σ_y	1.14	1.16	1.16	0.49
σ_i/σ_y	2.78	2.78	2.78	2.78
$corr(lev_t, y_t)$	-0.30	-	-0.31	0.08
Non-Targeted Moments				
σ_u/σ_y	6.28	0.33	0.37	0.89
σ_R	0.34	0.04	0.04	0.20
$corr(lev_t, y_t)$	-0.30	-0.63	-	-
$corr(ca_t/y_t, y_t)$	-0.47	-0.96	-0.62	0.30
$corr(R_t, y_t)$	-0.35	-0.19	-0.23	0.44
$corr(u_t, y_t)$	-0.85	-0.67	-0.68	-0.57
$corr(n_{SE,t}, y_t)$	-0.45	-0.45	-0.33	0.43
$corr(p^u(\theta_{SE,t}), y_t)$	-0.43	-0.93	-0.67	–
$corr(y_t, y_{t-1})$	0.85	0.72	0.75	0.77
$corr(u_t, u_{t-1})$	0.88	0.81	0.83	-0.19

Figure 1. Response to a Negative Aggregate Productivity Shock

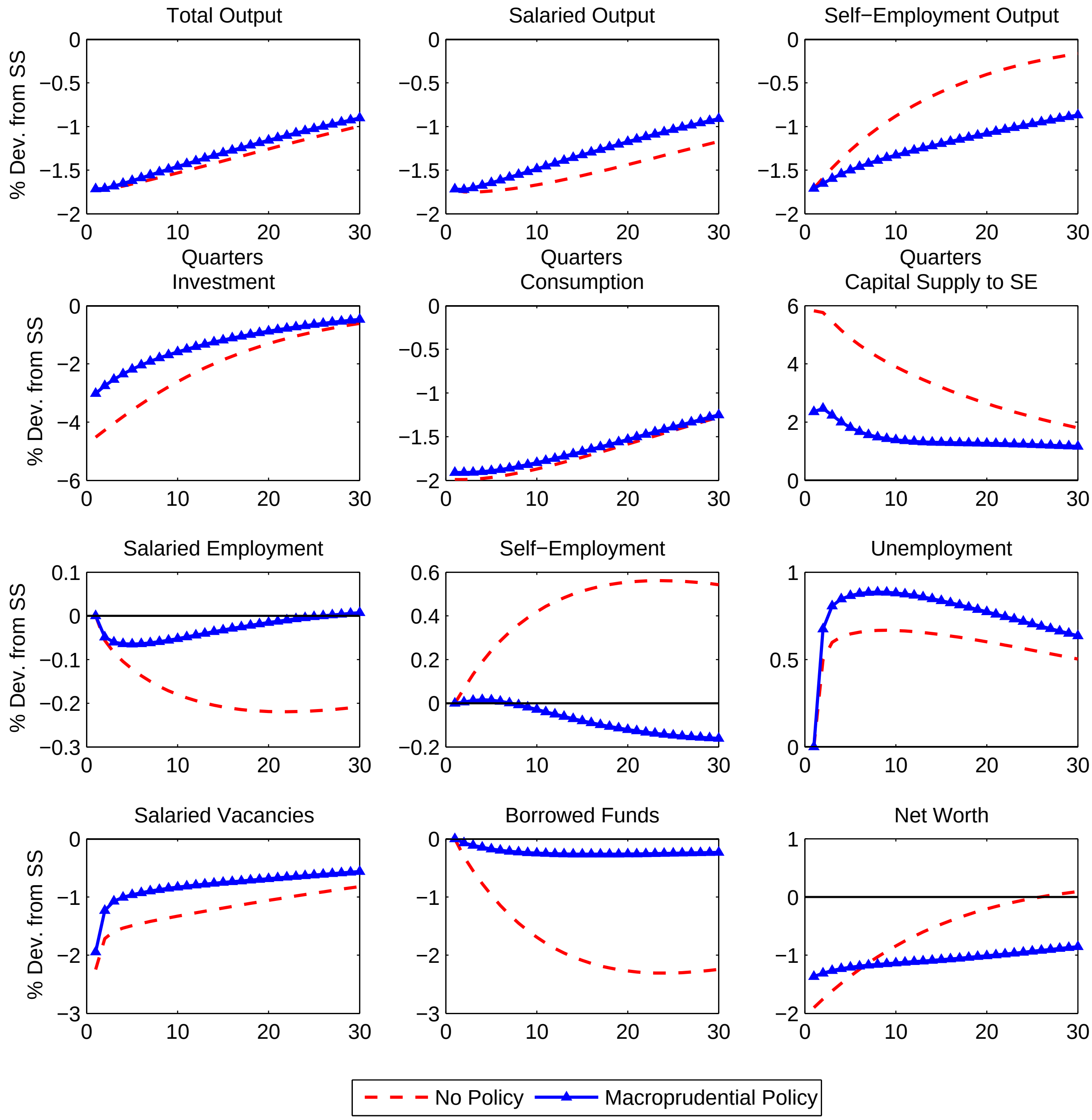


Figure 2. Response to a Negative Net Worth Shock

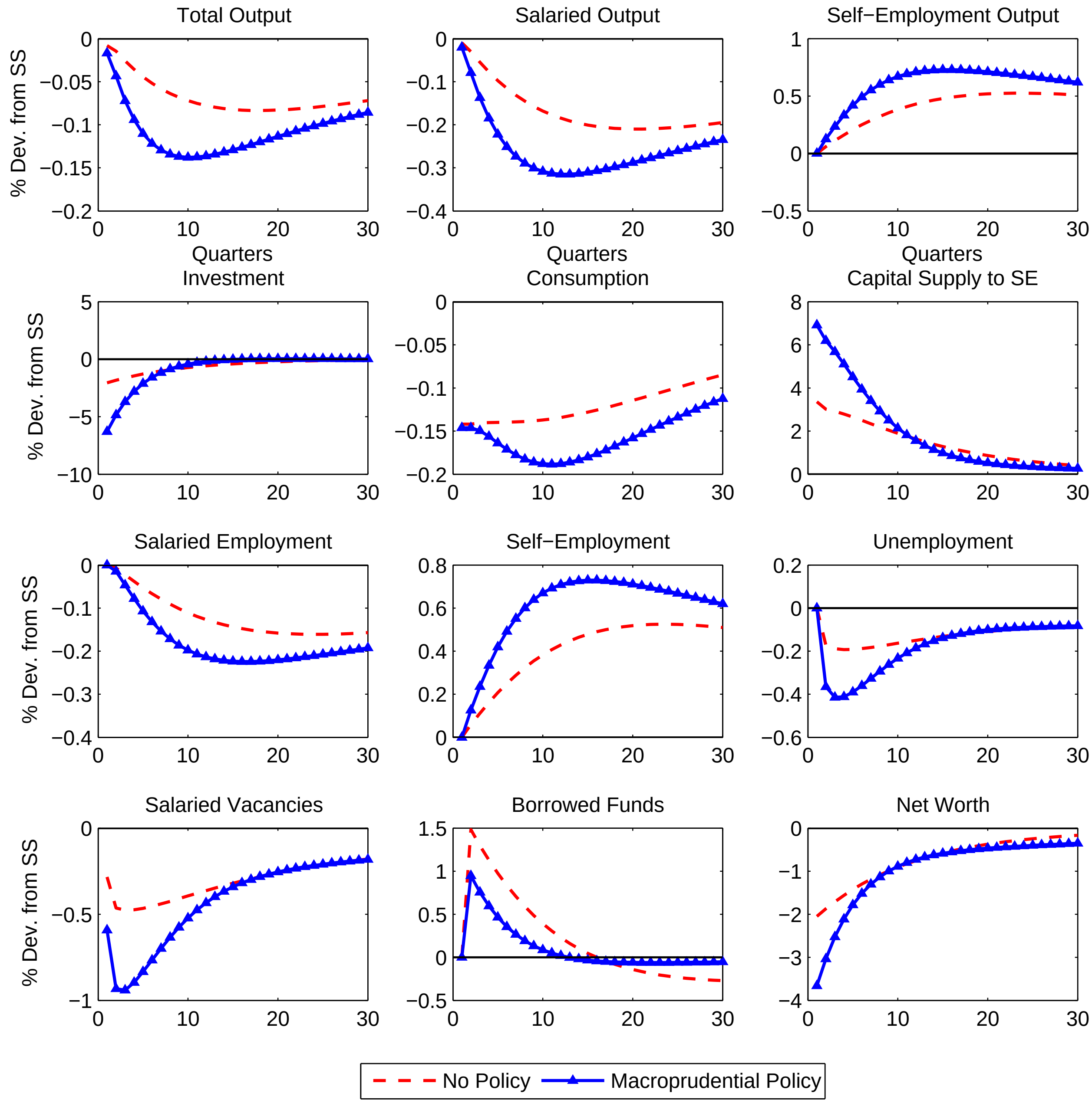
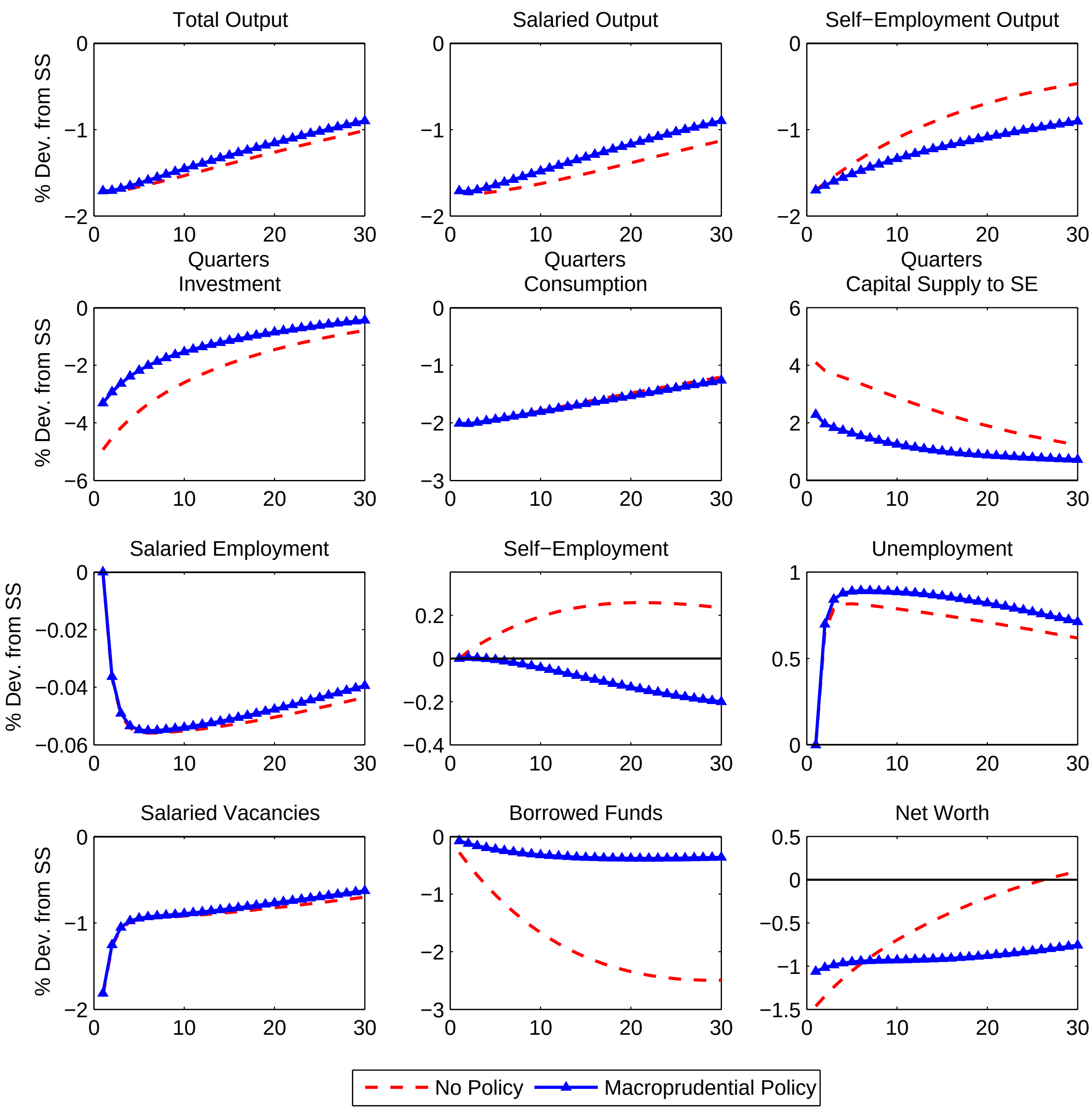


Figure 3. Response to a Negative Aggregate Productivity Shock – Benchmark Model with Household Heterogeneity



A.5. Calibration Parameters for Model with Only Productivity Shocks

In the model with only productivity shocks, we calibrate the investment adjustment cost, the volatility of the aggregate productivity shock, and the persistence of the shock to match the volatility of total output (2.39), the relative volatility of consumption (1.14), and the relative volatility of investment (2.78).

Table 7. Calibrated Parameters and Targets: Benchmark Economy

Parameter	Value	Parameter Description	Target in the Data
b^*	0.950	Steady State Foreign Debt	$b^*/4y = 0.30$
g	0.081	Steady State Gov. Spending	$g/y = 0.102$
M_S	0.154	Sal. Match. Efficiency	$n_S = 0.72$
M_{SE}	0.081	SE Match. Efficiency	$n_{SE} = 0.23$
ν_S	0.070	EFP Elasticity	Leverage Ratio of 1.73
ϕ_v	0.050	Fraction of nw_S, Exiting Firms	1 percent of wages
ψ_S	0.020	Salaried Vacancy Cost	3.5 percent of wages
ψ_{SE}	0.573	Project Posting Cost	3 months of wages
η_b	0.05	Elasticity of Foreign Debt	See Text
ρ_z	0.970	Autocorrelation of z	See Text
σ_z	0.0185	Standard Dev. of z	See Text
φ_k	8.82	Investment Adjustment Cost	See Text