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Abstract[*]

This paper builds a small open economy business cycle model with labor and financial market frictions that incorporates frictional, endogenous self-employment entry and a link between formal credit markets, informal credit, and the labor market. The paper then shows that the model is consistent with the cyclical behavior of both labor and credit markets in Latin American economies and analyzes the aggregate consequences of cyclical macroprudential policy for labor market and aggregate dynamics. It is found that a policy that reduces credit fluctuations successfully reduces consumption, investment, and output volatility, but generates substantially higher unemployment fluctuations in response to productivity shocks. Moreover, the policy increases the volatility of all these variables in response to net worth shocks. The link between formal credit markets, input credit between firms, and self-employment plays a key role in explaining the adverse impact of macroprudential policy on unemployment dynamics. The findings point to potential gains from policy complementarities between macroprudential regulation and active labor market interventions over the business cycle.

JEL Classification: E24, E32, G18, O17
Keywords: Business cycles, Labor search, Macroprudential policies, Financial frictions

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1. Introduction

The recent financial crisis highlighted the strong connection between financial markets, labor markets, and aggregate economic activity in developed countries. As financial market development and credit deepening continue to take hold in Latin American economies, it is crucial to better understand the consequences of financial market imperfections for labor markets and short-run economic activity in the region.[1] The lack of proper safety nets in most developing countries makes these issues even more relevant since adverse shocks can lead to higher potential welfare costs from employment fluctuations relative to developed countries. Thus, policies aimed at fostering financial and macroeconomic stability, such as cyclical macroprudential policies, have recently gained attention among policymakers in Latin America.[2] However, the effectiveness of these policies is still not well known, especially in environments where the structure of labor markets is deeply intertwined with both formal and informal financial markets, as is the case in many Latin American countries.[3]

We build small open economy business cycle model with financial and labor market frictions consistent with the employment and firm structure of many Latin American economies. In particular, we account for three important facts: self-employment represents an important share of total employment; micro and small firms rely on informal input financing from other firms (IDB, 2005, and Kantis, Angelelli and Moori Koenig, 2005); and only a segment of firms in the economy has access to formal external financing from financial institutions (World Bank, 2014). We use the model to explore the impact of cyclical macroprudential policy—mainly, a policy that limits credit fluctuations over the business cycle—on labor market and aggregate dynamics. To the best of our knowledge, this is the first paper to capture important characteristics of the composition of employment and the cyclical dynamics of Latin American labor and capital markets in a setting with standard financial frictions. We are also the first to study the impact of cyclical macroprudential policies in such an environment. We place heavy emphasis on the consequences

[1] For more on the recent credit expansion in Latin America, see Harbo Hansen and Sulla (2013). For an overview of the possible macroprudential interventions that Latin American countries can adopt, see Jácome, Nier, and Imam (2012).

[2] See, for example, de la Torre, Ize and Schmukler (2012).

[3] In this paper, informal credit 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.

of these policies for employment dynamics, where the latter have been largely ignored in the literature on macroprudential policy and in policy discussions of financial stability in the region.

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 documented in Fernández and Gulan (2014), as well as the cyclical dynamics of salaried employment and self-employment in Bosch and Maloney (2008). Second, we find that, while cyclical macroprudential policy can successfully reduce the volatility of consumption, investment, and output in response to productivity shocks, the policy generates asymmetric output responses across sectors and more importantly, larger unemployment fluctuations. Moreover, the same policy amplifies the response of all variables, including unemployment, in response to net worth shocks in the salaried sector. The interaction between firms that rely on formal financing and the self-employed, which takes place via frictional informal input credit markets, plays a key role in explaining the impact of policy on the cyclical behavior of unemployment.

We focus on macroprudential policy and abstract from monetary policy for three main reasons. First, given that the interaction between labor and financial market frictions has not been studied in detail in a developing country context, abstracting from nominal rigidities yields a more transparent framework to better understand the link between credit and labor markets. As a first step, this provides a clear setting in which to study the consequences of policies that aim to reduce credit fluctuations when an important segment of private-sector firms that does not directly participate in formal financial markets is nonetheless indirectly connected to the financial system via other firms.[4] Second, the recent period of high credit growth and relatively low and stable inflation in several Latin American countries with explicit inflation targeting regimes suggests that policymakers may have limited ability to use conventional monetary policy to explicitly tackle credit cycles. Third, as some of the existing literature suggests, monetary policy may not be the best instrument to deal with credit fluctuations when financial frictions and the reach of regulation differ across sectors, as is the case in countries where only a small fraction of firms have access to formal financing. These last two facts make macroprudential policy particularly appealing as a tool to promote financial and macroeconomic stability. In addition, we focus on *cyclical* policies since Latin America currently has high prudential buffers (de la Torre, Ize and Schmukler, 2012),

[4] Given the results in this paper, we plan to analyze the complementarities and tradeoffs between macroprudential policy and monetary policy and their impact on employment dynamics in developing countries in future work.

implying that studying the impact of cyclical policy interventions may be more relevant for the region at this time.

Table 1. Distribution of Employment in Latin American Countries, Salaried Employment and Self-Employment

Country	Salaried Employment	Self-Employment
Argentina	75.68	24.32
Bolivia	59.44	40.56
Brazil	76.68	23.32
Chile	78.01	21.99
Colombia	58.65	41.35
Dominican Republic	60.5	39.5
Ecuador	72.99	27.01
Guatemala	71.78	28.22
Mexico	79.12	20.88
Paraguay	65.99	34.01
Peru	62.81	36.19
Uruguay	73.66	26.34
Venezuela	61.32	38.68

Source: Table 2.1, p. 49, Chapter 2 in Perry et al. (2007). Salaried employment is comprised of formal and informal salaried employment. Self-employment is comprised of formal and informal self-employment, where the latter accounts for more than 90 percent of total self-employment.

Table 2. Firm Size Distribution in Selected Latin American Countries

	Firm Size			
Country	Micro	Small	Medium	Large
Argentina	81.6	16.1	1.9	0.4
Brazil	85.4	12.1	1.4	1
Chile	90.4	7.8	1.2	0.6
Colombia	93.2	5.5	1	0.3
Ecuador	95.4	3.8	0.6	0.2
Mexico	95.5	3.6	0.8	0.2
Peru	98.1	1.54	0.34	0.02
Uruguay	93.8	13.4	3.1	0.6

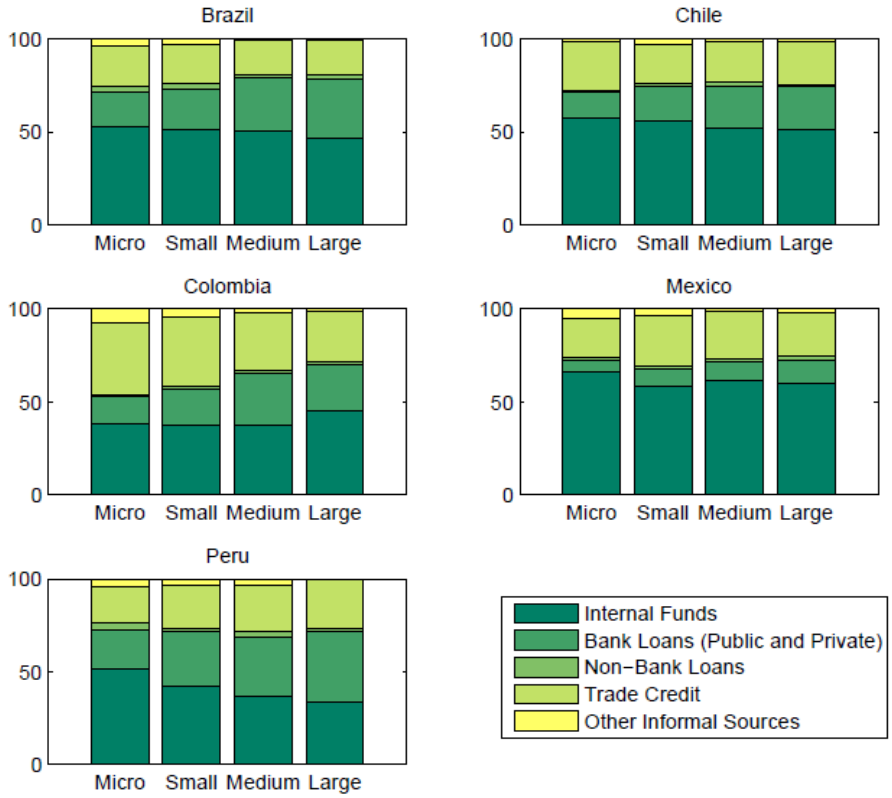
Source: Taken directly from Table 2.2 in OECD (2012).
Note: Micro firms have less than 5 workers, small firms have between 5 and 19 workers, medium firms have between 20 and 99 workers, and large firms have 100 or more workers.

Four key facts, summarized in Tables 1 through 4 and in Figure 1, motivate the structure of our model. First, as mentioned above, self-employment represents anywhere between 20 to 40 percent of total employment in Latin America (Table 1 in World Bank, 2012). Moreover, in contrast to salaried employment, both self-employment and entry into self-employment from unemployment are countercyclical (Bosch and Maloney, 2008). Second, the majority of firms in the region are either microfirms, most of which are owner-only, or small firms (Table 2). Third, external financing from banks for formal firms increases with firm size, and trade credit tends to be more prevalent among micro and small firms (Figure 1).[5] While large firms in the region tend to use bank financing as one of their main sources of financing (World Bank, 2014), micro-level evidence suggests that capital constraints and access to credit represent important obstacles for a large fraction of micro and small firms in Latin American economies.[6] More importantly, a large fraction of firms in these economies are informal, and therefore lack access to formal financing. One consequence from limited access to formal financing is reduced scale, as well as increased usage of informal financing, mainly trade credit from suppliers and customers (Tables 3 and 4). This implies that two types of financial frictions are at play: one focused on the relationship between firms and formal financial intermediaries, and one focused on the link between firms via interfirm (informal) trade credit.

[5] The facts in Figure 1 are based on surveys that focus on formal firms and therefore exclude a non-negligible share of firms in Latin America.

[6] For evidence on the importance of credit constraints in Latin American countries, see Galindo and Schiantarelli (2002), among others.

Figure 1. Sources of Financing by Firm Size: Selected Latin American Countries



Source: Figure 3.A1, OECD (2012).
Note: The firm sample for all countries includes formal firms only. Other informal sources refer to moneylenders, friends, and family. Trade credit refers to credit obtained through suppliers and customers. Non-bank loans refer to loans from non-bank financial institutions.

Table 3. 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
Search for Partners	11
Search for Support from Suppliers, Customers	51
Delay in Launching Enterprise	32

Notes: The original source of the data is Table 6.5 of Kantis, Angelelli and Moori Koenig (2005). This table is borrowed from Epstein and Finkelstein Shapiro (2014), who use selected data from Table 6.5 of Kantis, Angelelli and Moori Koenig (2005).

Table 4. Percent of Small Entrepreneurs Using Informal Financing in Latin America

Source of Financing	Startup Year	Early Years
Financing from Suppliers	32	36.6
Financing via Purchase of Second-Hand Machinery and Equipment	27.5	20.6
Financing from Customers	18	19.1

Notes: The original source of the data is Table 6.2 of Kantis, Angelelli and Moori Koenig (2005). This table is borrowed from Epstein and Finkelstein Shapiro (2014), who use selected data Table 6.2, Kantis, Angelelli and Moori Koenig (2005).

Our model is consistent with all these facts, where we consider the latter as relevant for a more comprehensive analysis of financial stability policies. In our framework, salaried firms produce using salaried workers and two types of capital, labeled as "generic" and "firm-specific." The first type of capital is purchased from capital producers using borrowed funds (formal credit), as in Bernanke, Gertler, and Gilchrist (1999), henceforth BGG. This introduces a standard financial accelerator mechanism among salaried firms, and a tractable environment where we can study the consequences of cyclical macroprudential policy. The second type of capital is accumulated internally. To introduce informal credit, we assume that salaried firms decide how much firm-specific capital is used within the firm. The remaining capital takes the form of input credit for self-employed ventures, and is supplied via frictional capital markets. This capital search structure follows from Finkelstein Shapiro (2014), who models endogenous and frictional entry into self-employment as a search process for input suppliers to capture the prevalence of interfirm credit among small firms in developing countries and the cyclicality of self-employment and entry into self-employment in the data.[7] One of the novel aspects of our work is that formal financial sources, frictional (informal) input credit markets, and the labor market are intertwined. These links across credit and labor markets have received little attention in the business cycle literature, despite their importance in many developing countries.

Our results stress the integral link between labor markets, informal financing, and formal credit and its importance for a more comprehensive assessment of macroprudential policies. The

[7] As shown in that paper, search frictions are ideal for capturing the relationship-based nature of input credit. While information asymmetries motivate the framework in BGG, we abstract from agency problems in trade credit contracts since existing evidence suggests that input credit can help partially offset information asymmetries (Burkart, Ellingsen, and Giannetti, 2011).

intuition behind the adverse effect of policy on unemployment dynamics is as follows. Cyclical macroprudential policy affects the cost of external funding and influences salaried firms' decisions to provide capital to the self-employment sector in response to shocks. In turn, the availability of external resources for self-employment ventures determines the cyclical response of self-employment entry and self-employment, which ultimately affect the behavior of unemployment. While an active macroprudential policy reduces the volatility of capital supply to the self-employment sector, vacancies, investment, and salaried output in response to productivity shocks, it reduces the countercyclicality of self-employment and generates both larger and long-lasting deviations in self-employment relative to an economy with no policy. This takes place because the policy reduces the incentive to supply capital to the self-employed relative to an economy with no policy, and this limits the shock-absorption features of self-employment in the labor market. When the economy is subject to a negative worth shock, consumption, investment, and output all contract, even as salaried firms reallocate part of their idle resources towards the self-employment sector. An active macroprudential policy exacerbates this reallocation effect by reducing the incentive to increase the desired amount of borrowed funds in the salaried sector, thereby generating sharper fluctuations in all variables, including unemployment. The behavior of self-employment in response to policy ultimately leads to larger unemployment fluctuations, regardless of the type of shock. Our findings carry important policy implication, as weak safety nets in most Latin American economies imply that unemployment fluctuations can generate larger welfare losses relative to developed countries. Moreover, they emphasize an important transmission channel that has been ignored in policy discussions and highlight some relevant tradeoffs between credit stability policies and labor market volatility in the region. Rather than dismissing the benefits of macroprudential policy, we interpret our findings as suggesting that policy complementarities, in particular between cyclical macroprudential interventions and active labor market policies, may be worth exploring in discussions of the benefits and costs of macroprudential regulation.

Following the literature on business cycles and financial frictions (Calstrom and Fuerst, 1997; BGG, 1999), several papers have introduced financial market imperfections into small open economy models (Gertler, Gilchrist, and Natalucci, 2007; Christiano, Trabandt and Walentin, 2011; and Fernández and Gulan, 2014, among others). Another expanding strand of the literature

has used these models to explore the consequences of macroprudential regulations.[8] Some recent work has also delved deeper into the interaction between labor and financial frictions, focusing on developed countries (Mumtaz and Zanetti, 2011; Zhang, 2012; Chugh, 2013). However, the literature has paid little attention to financial imperfections and labor market dynamics in developing countries.[9] Our work contributes to the nascent literature on labor market dynamics, financial frictions, and business cycles in developing countries by establishing a connection between standard formal financial frictions, informal financial frictions, and labor markets in line consistent with the structure of economic activity in many developing countries. Another contribution is the analysis of macroprudential policy with a focus on the consequences for employment dynamics, a theme that has been absent in the literature on financial stability.[10] While our results on the impact of macroprudential policy on labor market dynamics are new, Suh (2012) finds that policies that reduce credit fluctuations in one market generate outflows of credit to other parts of the market where regulations are less prevalent. The presence of formal and informal credit in our model generates the opposite result, where a reduction in the variability of credit in the salaried sector reduces the supply of credit (and its volatility) to the self-employment sector. However, the way credit and labor markets are linked in our model implies that stabilization policies can generate an amplification effect in the labor market.[11]

The paper is structured as follows. Section 2 describes the model, with the main novel feature being the inclusion of endogenous, frictional entry into self-employment in a framework with a standard financial accelerator mechanism in the salaried sector, all within a context that links self-employment and the salaried sector via frictional capital markets. Section 3 describes the calibration of the model. Section 4 discusses the results from evaluating a macroprudential policy that limits fluctuations in credit. Section 5 discusses a number of robustness tests and extensions. Section 6 concludes.

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[8] See Kiley and Sim (2012) for the United States, Benigno et al. (2013) and Filiz Unsal (2013) for two open-economy applications, and González, Hamann, and Rodríguez (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 that abstract from nominal rigidities and monetary policy. For a recent empirical analysis of the efficacy of macroprudential policies, see Claessens, Ghosh, and Mihet (2013).

[9] Fernández and Herreño (2013) is one recent exception. The authors introduce frictional unemployment in a small open economy model with collateral constraints to explore the dynamic behavior of unemployment during crisis episodes. While this model includes two types of salaried labor, it abstracts from modeling self-employment, the role of small firm creation in response to changing aggregate economic conditions, and alternative sources of financing.

[10] For a recent review of the literature on macroprudential policy, see Angelini, Nicoletti-Altimari and Visco (2012) and the references therein.

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

2. The Model

2.1 Inter-Firm Input Credit Relationships Among Small Firms[12]

Most self-employed and small firms rely on household resources as well as friends and family to start their ventures. However, alternative external sources of financing also play a crucial role for small and young firms (Demirgüç-Kunt and Maksimovic, 2001; Chavis, Klapper, and Love, 2011).[13] While comprehensive data on informal financing is scarce, existing studies suggest that input credit from suppliers and customers (including the purchase of used machinery and equipment from particular sellers) are some of the most important sources of external financing for small and young firms.[14] Importantly, interfirm credit is often based on goods rather than cash loans, especially in economies with a deficient institutional environment (Burkart and Ellingsen, 2004). These facts motivate the structure of the model, where salaried (larger) firms with access to external financing establish input credit relationships with self-employed individuals, who need external resources to start and operate their small business ventures.

In addition, the trade credit literature finds evidence of counteryclical 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.[15] More recently, 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.[16] Other studies have found that leasing and renting of capital—which

[12] A similar overview of the facts can be found in Finkelstein Shapiro (2014).

[13] For example, Chavis, Klapper and Love (2011) document that 30 percent of firms between 1 and 2 years old rely on trade credit, whereas 30 percent of firms of the same age rely on financing from other informal sources.

[14] In Latin America, 32 percent of entrepreneurs finance their operations by using suppliers, 27.5 percent by purchasing used machinery and equipment (which may depend critically on finding the right seller), and 18 percent by relying on customers (Kantis, Angelelli and Moori Koenig, 2005). All these financing sources can be broadly labeled as input credit since they are characterized by matching processes or (long-term) relationships between agents that take time and resources to materialize. While this evidence applies more to small but dynamic firms, the reliance of microfirms on these sources of external financing is likely to be as important since this group of firms is often more constrained by the lack of alternative sources of financing (including bank financing).

[15] High-frequency data and evidence on trade credit for developing countries are scarce. The data from these studies come from Worldscope and include publicly traded non-financial firms (and hence large firms with better access to formal financial markets).

[16] The authors use the World Bank's Financial Crisis Survey, which includes firms of all sizes, from different sectors, from different geographic locations, and both exporter and non-exporter firms in each of the countries studied. They document that in 2009, almost 50 percent of firms extended trade credit. In Lithuania and Romania, two of the

requires establishing a relationship with the owner of capital—is countercyclical (Gal and Pinter, 2013). This evidence offers one way to reconcile the presence of capital constraints among small firms with the countercyclicality of transitions from unemployment into self-employment.

2.2 Model Structure

The model merges the labor market structure in Finkelstein Shapiro (2014) with a small-open economy model that incorporates a financial accelerator (BGG, 1999), similar to Fernández and Gulan (2014). There are five agents in the economy: salaried firms (or BGG entrepreneurs), households, matching agencies, generic capital producers, and a government.[17] A single tradable good is produced by two different sectors, one populated by salaried firms and the other by self-employed firms. Each sector uses a different technology and different financing sources. Salaried firms use salaried labor and two types of capital, labeled as generic and firm-specific, to produce. The two types of capital can be imperfect substitutes or complements.[18] Firm-specific capital is accumulated internally whereas firms purchase generic capital from capital producers using borrowed funds (formal credit). As in the standard BGG model, lenders face a costly verification problem, which implies that firms face an external finance premium when they borrow funds to purchase generic capital. Following Finkelstein Shapiro (2014), salaried firms also choose the fraction of firm-specific capital used within the firm, which in turn determines the availability of capital for the self-employment sector.

Matching agencies purchase the firm-specific capital that salaried firms decide to supply and match it with potential self-employed individuals. This capital is labeled as input credit. Matching agencies also post vacancies to attract potential salaried workers. Matched workers are sent to the salaried sector. In order to attract capital for self-employment ventures, households

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countries that experienced the sharpest output contractions in the sample, 40 percent of firms *increased* the volume of goods sold using trade credit (compared to 23 percent in other countries that faced smaller recessions).

[17] The inclusion of matching agencies is borrowed from Zhang (2012) and is purely expositional: these agencies allow us to have a cleaner description of the economy by separating the description of the BGG financial frictions from the description of the labor and capital matching frictions in the salaried sector.

[18] We include two types of capital for the following reasons: first, some firms accumulate and use capital that is less liquid given its features (such as its sectoral specificity). While this capital can be supplied to other firms (even if these firms are in other sectors), the nature of that capital is such that search (as opposed to spot) markets are a better characterization to capture the allocation of this kind of capital. Second, with a single type of capital that is subject to BGG-style frictions, a shock to net worth or productivity would directly affect the self-employed sector through the supply of capital to that sector. While this is one possible scenario, it is also possible that salaried firms absorb part of the shock. The setup with two types of capital is more flexible and allows us to explore different scenarios that depend on, among other things, the substitutability between the two types of capital.

spend resources to find capital suppliers. A match between these resources and the matching agency's capital supply allows unemployed individuals to transition into self-employment. Each self-employed individual needs a single unit of capital to produce.[19] These individuals remain self-employed until the input credit relationship with the matching agencies ends, which occurs for exogenous reasons. Wages and capital rental rates are determined via Nash bargaining.

Before describing the details of the model, recall that the BGG structure captures the presence of information asymmetries between lenders and borrowers, which give rise to an external finance premium. If agency problems are important in formal financial contracts, they are likely to be more prevalent among micro and small firms in developing countries. Our trade credit structure abstracts from information asymmetries between the self-employed and salaried firms since input credit can help reduce these information problems since suppliers may have better information about the sector where their customers operate, more effective enforcement mechanisms, and lower monitoring costs relative formal financial institutions (see Burkart, Ellingsen, and Giannetti, 2011).

2.3 Households and the Self-Employed

Following the literature, we assume 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. The problem of the household is to choose sequences of consumption c_t, the desired measure of self-employment $n^h_{SE,t+1}$, expenditures on capital search $v_{SE,t}$, deposits d_t, and foreign debt b^*_t to[20]

$$\max E_0 \sum_{t=0}^{\infty} \beta^t [u(c_t)], \tag{1}$$

subject to the budget constraint

$$c_t + \kappa(v_{SE,t}) + d_t + T_t + (1-\phi_v)(1-\phi)V_{S,t} + R^*_{t-1}b^*_{t-1} =$$
$$(z_t - r_{SE,t})n^h_{SE,t} + b^*_t + w_{S,t}n_{S,t} + \Pi_{M,t} + d_{t-1}R_{t-1} + bu_t, \tag{2}$$

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

[20] Technically, 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.

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

$$n^h_{SE,t+1} = (1 - \delta^{SE})(n^h_{SE,t} + v_{SE,t}p(\theta_{SE,t})). \quad (3)$$

R_t is the gross domestic interest rate. The term $\kappa(v_{SE,t})$ denotes total expenditures on capital search, which we interpreted broadly as the startup costs for self-employment ventures. The interest rate on foreign debt is given by $R^*_t = R^*[\Theta(b^*_t - b^*)]$ 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 debt holdings. The amount $(1 - \phi_v)(1 - \phi)V_{S,t}$ (defined below) is spent by the household when salaried firms (BGG entrepreneurs) exit, which happens with probability $(1 - \phi)$, and transfer a share $(1 - \phi_v)$ of their net worth to the households, where $0 \leq \phi_v \leq 1$. Self-employed individuals produce using their own labor (supplied inelastically and normalized to one) as well as one unit of capital obtained from establishing long-term relationships with matching agencies. Thus, the measure of self-employed individuals is given by $n^h_{SE,t}$. $p(\theta_{SE,t})$ is the probability of finding a capital supplier, given by $p(\theta_{SE,t}) = \frac{m(k_{M,t}, v_{SE,t})}{v_{SE,t}}$, where $m(k_{M,t}, v_{SE,t})$ is a constant-returns-to-scale matching function that brings together resources spent on capital search, $v_{SE,t}$, and capital from matching agencies, $k_{M,t}$. Profits from the agencies in charge of matching are given by $\Pi_{M,t}$. Households receive salaried labor income $w_{S,t}n_{S,t}$ from workers in salaried firms. The government imposes lump-sum taxes T_t to finance unemployment benefits b. Total production by self-employed firms is given by $y_{SE,t} = z_t n^h_{SE,t}$ where z_t is an aggregate productivity shock. Each self-employed individual pays $r_{SE,t}$ to rent capital in frictional markets, so that individual self-employment earnings are given by $(z_t - r_{SE,t})$. Note that, while households can hold debt and receive income from deposits, unemployed individuals still require matching with a capital supplier in order to move into self-employment and successfully start production in the sector.[21] Combining first-order conditions yields an optimal decision to enter self-employment:

[21] Alternatively, we can think of part of the deposits and debt as being used to finance part of the start-up costs for self-employment ventures (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.

$$\frac{\kappa'(v_{SE,t})}{p(\theta_{SE,t})} = (1-\delta^{SE})E_t\left\{\beta\frac{u_c(c_{t+1})}{u_c(c_t)}\left(z_{t+1} - r_{SE,t+1} + \frac{\kappa'(v_{SE,t+1})}{p(\theta_{SE,t+1})}\right)\right\}, \tag{4}$$

and standard Euler equations for deposits and debt:

$$u_c(c_t) = E_t\beta[R_t u_c(c_{t+1})], \tag{5}$$

$$u_c(c_t) = E_t\beta[R_t^* u_c(c_{t+1})]. \tag{6}$$

Combining the last two optimality conditions yields:

$$R_t = R_t^*. \tag{7}$$

For future reference, 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, define $\Xi_{t+1|t} = \frac{\beta u_c(c_{t+1})}{u_c(c_t)}$ as the household's stochastic discount factor. The optimal decision to enter self-employment simply equates the expected marginal cost of searching for capital to the expected marginal benefit of doing so. The latter is given by self-employment profits if the match survives the next period, $z_{t+1} - r_{SE,t+1}$, as well as the continuation value from the capital relationship, $\frac{\kappa'(v_{SE,t+1})}{p(\theta_{SE,t+1})}$. This optimality condition is identical to the one in Finkelstein Shapiro (2014).

2.4 Salaried Production

The production side of the economy is comprised of salaried firms and firms operated by self-employed individuals. We focus on salaried firms since the structure of self-employment production has been described above. For expositional purposes, we follow Zhang (2012) and separate the standard BGG frictions from the search frictions in the salaried sector by introducing matching agencies. These agencies are in charge of posting vacancies to find salaried workers and selling matched labor to salaried firms. Once a match materializes, workers are sent to the salaried sector. The agencies are also in charge of purchasing firm-specific capital from salaried firms and matching it with the resources that household spend on capital search.

Salaried firms (BGG entrepreneurs) are risk neutral, discount profits at rate β, and produce using a constant-returns-to-scale production function that takes salaried labor $n_{S,t}^d$ and two types of capital, $k_{G,t}$ and $k_{S,t}$, as inputs. The first type of capital $k_{G,t}$, which we call generic, is subject

to standard BGG frictions whereby firms must use their net worth and borrowed funds to make generic capital purchases. The second type of capital, labeled as firm-specific, is accumulated within the firm.[22] Firms choose the fraction of firm-specific capital used within the firm, and sell the rest to matching agencies, which in turn use it as input credit to the self-employment sector via frictional capital markets. Finally, each individual firm is subject to an idiosyncratic i.i.d. shock ζ_t that affects current production, where $E[\zeta_t] = 1$, in addition to a standard aggregate productivity shock, z_t. For expositional purposes, we abstract from indices specific to each salaried firm. Based on the above, salaried output for a given firm is $y_{S,t} = \zeta_t z_t f(n_{S,t}^d, \omega_{S,t} k_{S,t}, k_{G,t})$ and, given the properties of ζ_t, total output in the salaried sector is $y_{S,t} = z_t f(n_{S,t}^d, \omega_{S,t} k_{S,t}, k_{G,t})$.

The firms' problem is to choose sequences of salaried employment demand $n_{S,t}^d$, firm-specific capital $k_{S,t+1}$, the fraction of the firm-specific capital stock used in production today, $\omega_{S,t}$, generic capital $k_{G,t+1}$, and borrowed funds to finance generic capital purchases $b_{S,t}$ to[23]

$$\max E_0 \sum_{t=0}^{\infty} \beta^t \begin{Bmatrix} z_t f(n_{S,t}^d, \omega_{S,t} k_{S,t}, k_{G,t}) - p_{w,t} n_{S,t}^d - i_{S,t} \\ +p_{K,t}(1-\omega_{S,t}) k_{S,t} - Q_{G,t} k_{G,t+1} + Q_{G,t}(1-\delta) k_{G,t} \\ -\frac{\varphi_{k_S}}{2}\left(\frac{k_{S,t+1}}{k_{S,t}} - 1\right)^2 k_{S,t} + b_{S,t} - E_{t-1}[r_{G,t}] b_{S,t-1} \end{Bmatrix}, \tag{8}$$

subject to

$$k_{S,t+1} = i_{S,t} + (1-\delta)\omega_{S,t} k_{S,t}, \tag{9}$$

where $r_{G,t}$ is the return on generic capital. This return can be defined as $r_{G,t+1} \equiv s\left(\frac{Q_{G,t} k_{G,t+1}}{nw_{S,t+1}}\right) R_t$, where $nw_{S,t+1}$ is net worth (defined below) and $Q_{G,t}$ is the price of generic capital. Following Gilchrist and Zakrajšek (2011), $s\left(\frac{Q_{G,t} k_{G,t+1}}{nw_{S,t+1}}\right) = \left(\frac{Q_{G,t} k_{G,t+1}}{nw_{S,t+1}}\right)^{\nu_G}$ is the external finance premium, where $\nu_G > 0$ is the elasticity of the external finance premium with respect to the leverage ratio. $p_{w,t}$ is the cost per salaried worker, and $p_{K,t}$ is the return on the firm-specific capital that firms sell to the matching agencies, who in turn match that capital with potential self-employed individuals. Borrowed funds by the firm in $t+1$ are defined as

[22] These two types of capital can be imperfect substitutes or complements. Assuming imperfect substitution or complementarity makes the BGG frictions relevant and prevents firms from only using internal firm-specific capital to produce.

[23] We can write this problem exactly as in Bernanke, Gertler, and Gilchrist (1999) or Fernández and Gulan (2014) by specifying explicitly the cost of bankruptcy and the cutoff value for the optimal contract. The inclusion of search frictions necessarily implies a more complicated framework, so for the sake of transparency, we provide an easier setup that follows the exposition in Gilchrist and Zakrajšek (2011) and Zhang (2012).

$$b_{S,t} = Q_{G,t}k_{G,t+1} - nw_{S,t+1}. \tag{10}$$

Combining first-order conditions yields an optimal decision to supply firm-specific capital to matching agencies:

$$p_{K,t} - (1-\delta) = z_t f_{\omega_S k_S,t}, \tag{11}$$

where $f_{\omega_{S,t}k_{S,t}}$ is the partial derivative with respect to the second argument of the production function.[24] The optimal demand for salaried employment is given by

$$p_{w,t} = z_t f_{n_S^d,t}, \tag{12}$$

so that the price of each unit of labor is equal to the marginal product of labor. The Euler equation for firm-specific capital is

$$\left[1 + \varphi_{k_S}\left(\frac{k_{S,t+1}}{k_{S,t}} - 1\right)\right] =$$

$$E_t\beta\begin{Bmatrix} z_{t+1}f_{k_S,t+1}\omega_{S,t+1} + p_{K,t+1}(1-\omega_{S,t+1}) + (1-\delta)\omega_{S,t+1} \\ -\frac{\varphi_{k_S}}{2}\left(\frac{k_{S,t+2}}{k_{S,t+1}} - 1\right)^2 + \varphi_{k_S}\left(\frac{k_{S,t+2}}{k_{S,t+1}} - 1\right)\frac{k_{S,t+2}}{k_{S,t+1}} \end{Bmatrix}, \tag{13}$$

the optimality condition with respect to $k_{G,t+1}$ is

$$Q_{G,t} = E_t\beta\left[z_{t+1}f_{k_G,t+1} + (1-\delta)Q_{G,t+1}\right], \tag{14}$$

and finally, the optimality condition for borrowed funds $b_{S,t}$ (using the definition of $r_{G,t}$) is

$$1 = E_t\beta\left[s\left(\frac{Q_{G,t}k_{G,t+1}}{nw_{S,t+1}}\right)R_t\right], \tag{15}$$

where net worth $nw_{S,t}$ is given by

$$nw_{S,t+1} = \phi V_{S,t} + \phi_v(1-\phi)V_{S,t}, \tag{16}$$

and ϕ is the survival probability of firms. In turn, $V_{S,t}$ is defined as

$$V_{S,t} = z_{nw,t}\left(r_{G,t}Q_{G,t-1}k_{G,t} - E_{t-1}\left[r_{G,t}\right]\left(Q_{G,t-1}k_{G,t} - nw_{S,t}\right) + p_{K,t}(1-\omega_{S,t})k_{S,t}\right), \tag{17}$$

where $z_{nw,t}$ is an exogenous net worth shock. The component $\phi_v(1-\phi)V_{S,t}$ of 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

[24] The second argument represents the actual firm-specific capital used in production within the firm, and not total firm-specific capital.

includes the return to selling firm-specific capital to matching firms. As is standard in models with a financial accelerator, we can define the return on capital as

$$E_t[r_{G,t+1}] \equiv \frac{E_t\left[z_{t+1} f_{k_G,t+1} + (1-\delta) Q_{G,t+1}\right]}{Q_{G,t}}. \tag{18}$$

Then, we have

$$E_t[r_{G,t+1}] = E_t\left[s\left(\frac{Q_{G,t} k_{G,t+1}}{n w_{S,t+1}}\right) R_t\right]. \tag{19}$$

2.5 Matching Agencies

Following Zhang (2012), matching agencies separate the matching problem from the standard financial frictions in the salaried sector. In our framework, the matching agencies are in charge of both posting vacancies to find salaried workers *and* matching the capital they purchased from salaried-sector firms with potential self-employed individuals. The problem of the matching agencies is to choose sequences of salaried sector vacancies $v_{S,t}$, salaried sector employment $n^s_{S,t+1}$, firm-specific capital demand $k_{M,t}$, and self-employment capital $n^s_{SE,t+1}$ to[25]

$$\max E_0 \sum_{t=0}^{\infty} \Xi_{t|0} \begin{Bmatrix} p_{w,t} n^s_{S,t} - w_{S,t} n^s_{S,t} - \psi_S v_{S,t} \\ r_{SE,t} n^s_{SE,t} - p_{K,t} k_{M,t} + (\delta^{SE} - \delta) n^s_{SE,t} \\ + \left[(1-\delta) k_{M,t} - (1-\delta^{SE}) k_{M,t} q(\theta_{SE,t})\right] \end{Bmatrix}, \tag{20}$$

subject to the perceived laws of motion for salaried employment and self-employment capital (or self-employment)

$$n^s_{S,t+1} = (1-\delta^S)(n^s_{S,t} + v_{S,t} q(\theta_{S,t})), \tag{21}$$

and

$$n^s_{SE,t+1} = (1-\delta^{SE})(n^s_{SE,t} + k_{M,t} q(\theta_{SE,t})). \tag{22}$$

The first line inside the maximization problem captures the elements related to salaried employment; the second and third lines capture the elements related to capital search. Matching agencies receive $p_{w,t} n^s_{S,t}$ from selling matched labor to salaried firms, but must pay $w_{S,t} n^s_{S,t}$ to salaried workers and spend $\psi_S v_{S,t}$ on vacancy postings to attract workers. They also receive $r_{SE,t} n^s_{SE,t}$ from renting matched capital to the self-employed, but spend $p_{K,t} k_{M,t}$ to purchase

[25] In equilibrium, the matching agency's demand for firm-specific capital $k_{M,t}$, is equal to the salaried firms' supply of firm-specific capital, $(1-\omega_{S,t}) k_{S,t}$.

capital from salaried firms at price $p_{K,t}$. As in Finkelstein Shapiro (2014), capital from the self-employment sector separates at rate δ^{SE} and returns to the matching agencies, but matching agencies have to cover the depreciation of capital for surviving relationships, δ. This is captured by the term $(\delta^{SE} - \delta)n^{s}_{SE,t}$. Finally, the last expression is simply unmatched capital that stays within the matching agencies, where $q(\theta_{SE,t})$ is the probability of matching with a household searching for capital, $q(\theta_{SE,t}) = \frac{m(k_{M,t}, v_{SE,t})}{k_{M,t}}$. Similarly, the probability of filling a salaried sector vacancy is given by $q(\theta_{S,t})$, where $q(\theta_{S,t}) = \frac{m(u_t, v_{S,t})}{v_{S,t}}$ and $m(u_t, v_{S,t})$ is a matching function that brings together unemployed individuals u_t and vacancies in the salaried sector, $v_{S,t}$. The first-order conditions yield a standard job creation condition:

$$\frac{\psi_S}{q(\theta_{S,t})} = (1 - \delta^{S})E_t \Xi_{t+1|t} \left\{ p_{w,t+1} - w_{S,t+1} + \frac{\psi_S}{q(\theta_{S,t+1})} \right\}, \tag{23}$$

and an optimality condition that determines the supply of capital to the self-employment sector:

$$\frac{p_{K,t} - (1-\delta) + (1-\delta^{SE})q(\theta_{SE,t})}{q(\theta_{SE,t})} = \tag{24}$$

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

The matching agency equates the expected marginal cost of supplying capital to the self-employment sector to the expected marginal benefit of doing so. The expected marginal cost consists of two terms: the first one is the price at which matching agencies buy capital from salaried sector firms. The second one captures the fact that if a match occurs with probability $(1 - \delta^{SE})q(\theta_{SE,t})$, the matching agency has to keep the matched capital until it becomes productive next period. The agency must also take into account that capital depreciates at rate δ. The right-hand side of the capital supply condition captures the expected marginal benefit, which is given by the rental rate on matched capital $r_{SE,t+1}$, the benefit of getting back any separated capital net of depreciation, $(\delta^{SE} - \delta)$, and the continuation value of maintaining a capital relationship next period.[26]

[26] Taking into account the optimal $p_{K,t}$, this expression is identical to the optimal capital supply condition in Finkelstein Shapiro (2014).

2.6 Wage and Rental Rate Determination

The value to a worker of being employed in the salaried sector is

$$\mathbf{W}_{S,t} = w_{S,t} + E_t \Xi_{t+1|t}\left\{(1-\delta^S)\mathbf{W}_{S,t+1} + \delta^S \mathbf{W}_{U,t+1}\right\}. \tag{25}$$

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

$$\mathbf{W}_{SE,t} = (z_t - r_{SE,t}) + E_t \Xi_{t+1|t}\left\{(1-\delta^{SE})\mathbf{W}_{SE,t+1} + \delta^{SE} \mathbf{W}_{U,t+1}\right\}. \tag{26}$$

The value of an individual in unemployment is

$$\mathbf{W}_{U,t} = b + E_t \Xi_{t+1|t} \begin{Bmatrix} (1-\delta^S)p(\theta_{S,t})\mathbf{W}_{S,t+1} + (1-\delta^{SE})v_{SE,t}^{u} p(\theta_{SE,t})\mathbf{W}_{SE,t+1} \\ +[1-(1-\delta^S)p(\theta_{S,t}) - (1-\delta^{SE})v_{SE,t}^{u} p(\theta_{SE,t})]\mathbf{W}_{U,t+1} \end{Bmatrix}. \tag{27}$$

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

$$\mathbf{J}_{S,t} = p_{w,t} - w_{S,t} + E_t \Xi_{t+1|t}\left\{(1-\delta^S)\mathbf{J}_{S,t+1}\right\}. \tag{28}$$

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

$$\mathbf{J}_{SE,t} = r_{SE,t} + (\delta^{SE} - \delta) + E_t \Xi_{t+1|t}\left\{(1-\delta^{SE})\mathbf{J}_{SE,t+1}\right\}, \tag{29}$$

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

$$\max_{w_{S,t}}\left\{\left(\mathbf{W}_{S,t} - \mathbf{W}_{U,t}\right)^{\nu_S}(\mathbf{J}_{S,t})^{1-\nu_S}\right\}, \tag{30}$$

$$\max_{r_{SE,t}}\left\{\left(\mathbf{W}_{SE,t} - \mathbf{W}_{U,t}\right)^{\nu_{SE}}\left(\mathbf{J}_{SE,t} - \mathbf{J}_{u_k,t}\right)^{1-\nu_{SE}}\right\}, \tag{31}$$

where ν_S and ν_{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 $\mathbf{J}_{u_k,t} \equiv 1-\delta$. The wage and rental rates are implicitly given by

$$\left(\mathbf{W}_{S,t} - \mathbf{W}_{U,t}\right) = \frac{\nu_S}{1-\nu_S}\mathbf{J}_{S,t}, \tag{32}$$

$$\left(\mathbf{W}_{SE,t} - \mathbf{W}_{U,t}\right) = \frac{\nu_{SE}}{1-\nu_{SE}}\left(\mathbf{J}_{S,t} - (1-\delta)\right). \tag{33}$$

2.7 Capital Producers

The capital producers' problem is to choose a sequence of investment $i_{G,t}$ to

$$\max E_0 \sum_{t=0}^{\infty} \Xi_{t|0}\left[Q_{G,t}k_{G,t+1} - Q_{G,t}(1-\delta)k_{G,t} - i_{G,t}\right], \tag{34}$$

subject to the production technology for generic capital

$$k_{G,t+1} = (1-\delta)k_{G,t} + \Phi\left(\frac{i_{G,t}}{k_{G,t}}\right)k_{G,t}, \tag{35}$$

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

$$Q_{G,t} = \left[\Phi\left(\frac{i_{G,t}}{k_{G,t}}\right)\right]^{-1}. \tag{36}$$

2.8 Government, Market Clearing, and Definition of Total Output

The government collects lump-sum taxes from households to finance unemployment benefits. The government budget constraint is given by

$$T_t = bu_t. \tag{37}$$

The resource constraint is given by

$$\begin{aligned} y_t = c_t + \kappa\left(v_{SE,t}\right) + \psi_S v_{S,t} + i_{G,t} + (1-\phi_v)(1-\phi)V_{S,t} + i_{S,t} - (\delta^{SE}-\delta)n_{SE,t} \\ -\left[(1-\delta) - (1-\delta^{SE})q(\theta_{SE,t})\right](1-\omega_{S,t})k_{S,t} + b^*_{t-1}R^*_{t-1} - b^*_t \\ + \frac{\varphi_{k_S}}{2}\left(\frac{k_{S,t+1}}{k_{S,t}} - 1\right)^2 k_{S,t} + \left[s\left(\frac{Q_{G,t-1}k_{G,t}}{nw_{S,t}}\right) - 1\right]R_{t-1}b_{S,t-1}, \end{aligned} \tag{38}$$

where the last term on the right-hand side captures the bankruptcy costs of BGG salaried firms. Note that in establishing the resource constraint, we use the fact that the market for firm-specific capital clears:

$$(1-\omega_{S,t})k_{S,t} = k_{M,t}, \tag{39}$$

and the labor market clears:

$$n^s_{S,t} = n^d_{S,t} = n_{S,t}, \quad n^s_{SE,t} = n^d_{SE,t} = n_{SE,t}. \tag{40}$$

Finally, we define total output as

$$y_t = y_{S,t} + y_{SE,t}. \tag{41}$$

For future reference, we define total investment as the sum of investment in generic capital by capital producers and investment in firm-specific capital by salaried firms.

2.9 Competitive Equilibrium

Definition *(Competitive Equilibrium) Taking the set of exogenous processes* $\{z_t, z_{f,t}\}$ *as given, the allocations and prices* $\{c_t, n_{S,t}, \theta_{S,t}, \theta_{SE,t}, k_{S,t}, k_{G,t}, k_{M,t}, n_{SE,t}, \omega_{S,t}, u_t, b_{S,t}, b_t^*\}$ *and* $\{w_{S,t}, r_{SE,t}, r_{G,t}, p_{w,t}, p_{K,t}, Q_{G,t}, R_t\}$ *satisfy the law of motion for salaried employment; the job creation condition for salaried employment; the decision to enter self-employment; the Euler equation for firm-specific capital; the expected return on generic capital; the equilibrium quantity of capital available for matching; the law of motion for self-employment capital; the salaried firms' optimal capital supply to the matching agencies; the matching agencies' optimal supply of capital to the self-employment sector; the definition of unemployment; the definition of borrowed funds (or credit); the household's two Euler equations; the Nash wage; the Nash capital rental rate; the expression linking the rate of return on generic capital, the external finance premium, and the risk-free rate; the optimal demand for salaried employment; the optimal supply condition for generic capital by capital producers; and the resource constraint.*

3. Calibration

3.1 Functional Forms and Stochastic Processes

Salaried production is $f(n_{S,t}, \omega_{S,t}k_{S,t}, k_{G,t}) = \left(\left[\xi_S(\omega_{S,t}k_{S,t})^{\eta_S} + (1-\xi_S)k_{G,t}^{\eta_S}\right]^{\frac{1}{\eta_S}}\right)^{\alpha_S} n_{S,t}^{1-\alpha_S}$, where $0 < \alpha_S, \xi_S < 1$ and $\eta_S < 1$. The instantaneous utility function is CRRA $u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}$. 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 the matching efficiency parameter. Similarly, the matching function for capital is given by $m_{SE}(k_{M,t}, v_{SE,t}) = M_{SE}(k_{M,t})^{\xi}(v_{SE,t})^{1-\xi}$ where M_{SE} is the matching efficiency parameter. For simplicity, we assume the same matching elasticity for both functions. The capital search cost is given by $\kappa(v_{SE,t}) = \psi_{SE}(v_{SE,t})^{\eta_{SE}}$ 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 $\Phi\left(\frac{i_{G,t}}{k_{G,t}}\right) = \frac{i_{G,t}}{k_{G,t}} - \frac{\varphi_{k_G}}{2}\left(\frac{i_{G,t}}{k_{G,t}} - \delta\right)^2$. The aggregate productivity and net worth shocks follow standard independent AR(1) processes:

$$\ln z_t = (1 - \rho_z)\ln z + \rho_z \ln z_{t-1} + \varepsilon_t^z, \tag{42}$$

$$\ln z_{nw,t} = (1 - \rho_{z_{nw}})\ln z_{nw} + \rho_{z_{nw}} \ln z_{nw,t-1} + \varepsilon_t^{z_{nw}}, \tag{43}$$

where z and z_{nw} represent steady-state values, and $\varepsilon_t^j \overset{iid}{\sim} N(0, \sigma_j)$, $0 < \rho_j < 1$, for $j = z, z_{nw}$.

3.2 Parameters from Literature

We use Mexico as our benchmark economy since it has high quality data on labor flows. Table 5 presents the 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, consistent with a quarterly real interest rate of 1.015. The depreciation rate of capital is 0.025. The salaried and self-employment separation rates are set to 0.06 and 0.02, respectively (Bosch and Maloney, 2008). We set the convexity of the capital search cost function, η_{SE}, to 1.1 (Krause and Lubik, 2010).[27]

Table 5. Parametrization for Benchmark Economy

Parameter	Value	Parameter Description	Parameter Source
α^S	0.320	Capital Share, Salaried Sector	DSGE Literature
b	0.000	Unemployment Insurance	No Unemployment Benefits
β	0.985	Discount Factor	DSGE Literature
δ	0.025	Capital Depreciation Rate	DSGE Literature
δ^S	0.060	Salaried Separation Rate	Bosch and Maloney (2008)
δ^{SE}	0.020	SE Separation Rate	Bosch and Maloney (2008)
η_S	0.900	Elasticity of Substit. Between Capital	See Text
η_{SE}	1.100	Curvature of Capital Search Costs	See Text
ν_S	0.500	Salaried Bargaining Power	Search Literature
ν_{SE}	0.500	SE Bargaining Power	Search Literature
ξ	0.500	Matching Elasticity	Search Literature
φ	0.920	Survival Rate, BGG Salaried Firms	See Text
R^*	1.015	Foreign Interest Rate	DSGE Literature
σ	2.000	CRRA Utility Parameter	DSGE Literature

[27] The results are robust to different degrees of convexity.

The bargaining power of both salaried and self-employed workers and the matching elasticity are set to 0.5, following the literature. The elasticity of substitution parameter between firm-specific and generic capital is initially set to 0.90 such that the two types of capital are imperfect substitutes.[28] (common to both labor and capital markets) are set to 0.5.[29] The survival rate of 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 0.92, which is between the value used in Fernández and Gulan and the exit rate of Mexican manufacturing firms.[30] The foreign interest rate is set to 1.015, and the CRRA parameter in the utility function is 2.

3.3 Calibrated Parameters

Table 6 shows the calibrated parameters and their respective targets. We calibrate the steady-state ratio of debt to GDP to 10 percent (Aguiar and Gopinath, 2007). We use data from Mexico's National Survey on Urban Employment (ENEU) to 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. The elasticity of the external finance premium, ν_G, is chosen to match the leverage ratio for non-financial firms in Mexico, obtained from Fernández and Gulan (2014).

[28] Note that the elasticity of substitution between the two types of capital is given by $1/(1-\eta_S)$. Our results become stronger with lower elasticities as the two types of capital become closer to complements.
[29] The results are robust to a smaller bargaining power for self-employed workers.
[30] As Fernández and Gulan (2012) note, Calstrom and Fuerst (1996) use a value close to 0.88, so our calibration does not deviate much from other papers.

Table 6. Calibrated Parameters and Targets: Benchmark Economy

Parameter	Value	Parameter Description	Target
b^*	0.138	SS Foreign Debt	$b^*/y = 0.10$
M_S	0.183	Sal. Match. Efficiency	$n_S = 0.72$
M_{SE}	0.057	SE Match. Efficiency	$n_{SE} = 0.23$
ν_G	0.066	EFP Elasticity	Leverage Ratio of 1.73
ϕ_ν	0.069	Fraction of nw_S , Exiting Firms	1 percent of wages
ψ_S	0.035	Salaried Vacancy Cost	3.5 percent of wages
ψ_{SE}	1.008	Project Posting Cost	3 months of wages
ξ_S	0.341	Share of Firm-Specific k	$(i_T/i) = 0.64$
η_b	0.100	Elasticity of Foreign Debt	See Text
ρ_z	0.952	Autocorrelation of TFP	See Text
σ_z	0.0185	Standard Dev. of TFP	See Text
ψ_{kG}	6.000	Adjustment Cost, i_G	See Text
ψ_{kS}	4.000	Adjustment Cost, k_T	See Text

We set ϕ_v such that the net worth from exiting salaried firms that is used as startup capital for entering salaried firms is equivalent to 1 percent of wages, a small number. The salaried sector vacancy posting cost is calibrated to 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).[31] Using the World Bank Enterprise Survey, we set ξ_S to capture the share of investment financed internally in Mexico in 2010 (the only year available). 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. In the model with productivity shocks, we calibrate the firm-specific capital and generic capital investment adjustment costs, the persistence and volatility of the aggregate productivity shock, to match the relative volatilities of consumption and total investment (1.13 and 2.78, respectively), the volatility of total output (2.39), and the contemporaneous correlation between interest rates and output (-0.35).[32] The details of the

[31] 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}.. Also, a version of the model where salaried firms use both formal and informal salaried workers would yield similar qualitative results.

[32] We use data from 1993Q1 to 2007Q4 for Mexico, obtained from the Federal Reserve Bank of Saint Louis FRED

calibration with both productivity and net worth shocks are in the Appendix. We use standard local approximation techniques to simulate the model.[33]

4. Main Results

We begin by characterizing the cyclical dynamics of the model in an environment without cyclical 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 policy that reduces credit fluctuations over the business cycle.

4.1 Business Cycle Dynamics without Macroprudential Policy

Table 7 below presents some basic business cycle statistics for the benchmark (no-policy) economy. A model with productivity shocks as the sole driver of business cycles qualitatively replicates the countercyclicality of both unemployment and self-employment, as well as the countercyclicality of the transition probabilities from unemployment into self-employment. The model can also capture the countercyclicality of leverage and replicate other moments that are not explicitly targeted, such as the volatility of the transition probability from unemployment into self-employment, and the persistence of unemployment.

database, for consumption, investment, and output. All series are logged (when applicable) and HP-filtered using a smoothing parameter of 1,600. The targets for the interest rate are from Fernández and Gulan (2014).

[33] The equilibrium conditions are log-linearized around the model's steady state. We simulate the model for 2,100 periods, remove the first 100 periods, apply the Hodrick-Prescott (HP) filter with smoothing parameter 1,600 to the simulated series, and compute second moments as we would do with real data. We use Dynare for all simulations (Adjemian et al., 2011).

Table 7. Business Cycle Statistics: Data vs. Model

Second Moments	Data	Model with z Shocks	Model with Correlated z and z_{nw} Shocks
σ_y	2.390	2.39	2.39
σ_c/σ_y	1.140	1.13	1.13
σ_i/σ_y	2.780	2.79	2.79
σ_u/σ_y	6.280	0.12	0.15
$\sigma_{vse*p(\theta SE)}$	9.400	11.6	11.7
σ_R	0.340	0.08	0.08
$\rho(u_t,y_t)$	-0.848	-0.66	-0.588
$\rho(n_t,y_t)$	0.530	0.66	0.588
$\rho(n_{SE,t},y_t)$	-0.433	-0.389	-0.362
$\rho(v_{SE,t}p(\theta_{SE,t}),y_t)$	-0.350	-0.98	0.952
$\rho(R_t,y_t)$	-0.350	-0.298	-0.347
$\rho(lev_t,y_t)$	-0.300	-0.167	0.272
$\rho(y_t,y_{t-1})$	0.846	0.716	0.748
$\rho(u_t,u_{t-1})$	0.878	0.832	0.823

One of the main shortcomings of the model is that it underestimates the contemporaneous correlation of unemployment with output and the volatility of interest rates. Despite the model's limitations on the unemployment front (including its volatility relative to output, a well-known limitation in most labor search models), we can capture the behavior of the main labor market, financial market, and standard macro variables surprisingly well. A similar claim holds for a version of the model with both productivity and net worth shocks, which we focus on below. Importantly, the model is consistent with the stylized facts about financial markets in Fernández and Gulan (2014) as well as important cyclical facts about developing country labor markets.

4.2 Business Cycle Dynamics with Macroprudential Policy

We follow Filiz Unsal (2013) and consider a policy that affects the external finance premium when credit to the salaried sector deviates from trend. More specifically, we introduce a regulation premium $\tau_{G,t}$ such that the return on generic capital $r_{G,t}$ becomes

$$r_{G,t} = \left[s\left(\frac{Q_{G,t-1} k_{G,t}}{n w_{T,t}} \right) R_{t-1} \right] \tau_{G,t}, \tag{44}$$

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

$$\tau_{G,t} = \exp\left[\eta_G \left(\frac{b_{T,t-1}}{b_T} - 1 \right) \right]. \tag{45}$$

$\eta_G \geq 0$ governs the intensity of macroprudential policy.[34] This policy generates a larger spread between the domestic interest rate R paid on deposits and the interest rate paid on borrowed funds, r_G, during booms, and is similar to a cyclical reserve requirement on banks.[35] To highlight the main transmission channels in the model, we calibrate η_G such that the volatility of credit b_T is reduced by a factor of two.

4.3 Response to a Negative Aggregate Productivity Shock

Figures 2 and 3 show the response of the economy to a negative aggregate productivity shock under two scenarios: the benchmark economy ($\eta_G = 0$) and an economy with an active macroprudential policy ($\eta_G > 0$). Recall that 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 (even though the difference in total output dynamics relative to the economy without an active policy is small quantitatively), investment suffers smaller reductions on impact and returns to trend earlier, and net worth is initially more resilient to the shock when the policy is in place. Net worth does not fall as much due to the smaller contraction in borrowed funds under an active policy. However, the response of total output hides important compositional differences. Indeed, while the policy makes the fall in salaried output less persistent (which explains the behavior of total output), the smaller deviations in borrowed funds in the salaried sector affect the supply of firm-specific capital to the self-employment sector and generate a more persistent fall in self-employment output relative to the no-policy scenario. To understand this result, we turn to the impulse response functions for the labor market.

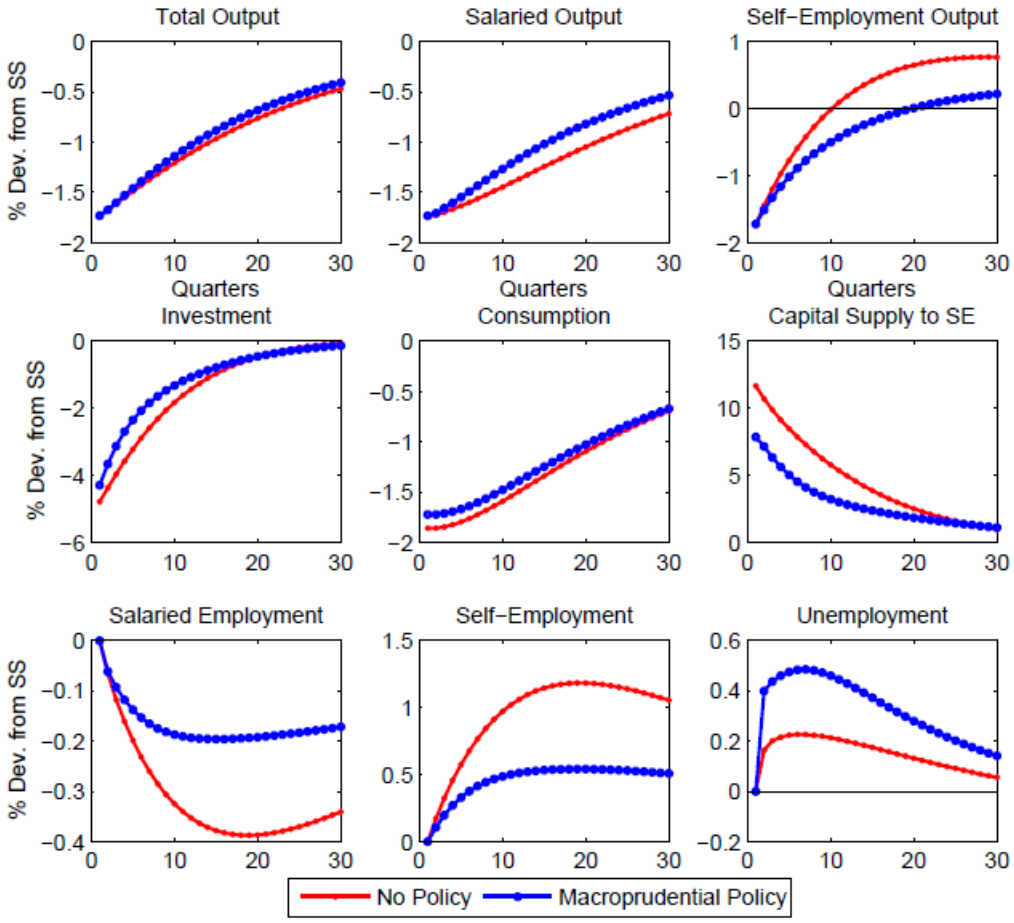
[34] We could also analyze the implications of introducing a transaction tax on borrowed funds as an alternative macroprudential policy intervention. In contrast to our focus on policies that respond to the business cycle, this policy would affect the steady state. We abstract from this policy because it 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.

[35] As mentioned in de la Torre, Ize and Schmukler (2012), several Latin American countries have experimented with modifications to reserve requirements as an instrument to tackle credit cycles.

As we argued above, the policy's presence limits the contraction in borrowed funds to the productivity shock, which in turn limits the negative response of generic capital purchases. Even if the two types of capital are imperfect substitutes, the subdued fall in borrowed funds under the policy pushes salaried firms to keep more of their firm-specific capital in-house relative to the no-policy case, which in turn creates a smaller and less persistent expansion in the supply of capital to the self-employment sector relative to an economy without policy.[36] Note that the smaller expansion in the supply of firm-specific capital available to enter self-employment implies that the marginal product of salaried labor falls by less under the policy, so the demand for salaried labor (and hence salaried vacancies) falls by less on impact as well. This explains the smaller contraction in salaried employment in the aftermath of the shock. At the same time, the smaller increase in the availability of capital to the self-employed generates an expansion in self-employment that is both smaller and less persistent under the macroprudential policy. Importantly, as aggregate productivity slowly returns to steady state, the initial increase in the availability of capital begins its return back to steady state. This occurs earlier under the policy and creates a long-lasting contraction in self-employment over time. In relative terms, this contraction in self-employment more than offsets the recovery of salaried employment and generates a larger and more persistent rise in unemployment in the aftermath of the shock. Even though self-employment accounts for a smaller share of total employment than salaried employment, its dynamic response to the shock plays an important role in determining unemployment fluctuations.

[36] Under both scenarios, there is an expansion of available firm-specific capital for the self-employment sector since firm-specific capital usage falls regardless of whether we have a policy in place or not. In turn, this generates an increase in self-employment entry and self-employment in the aftermath of the shock.

Figure 2. Response to a Negative Productivity Shock

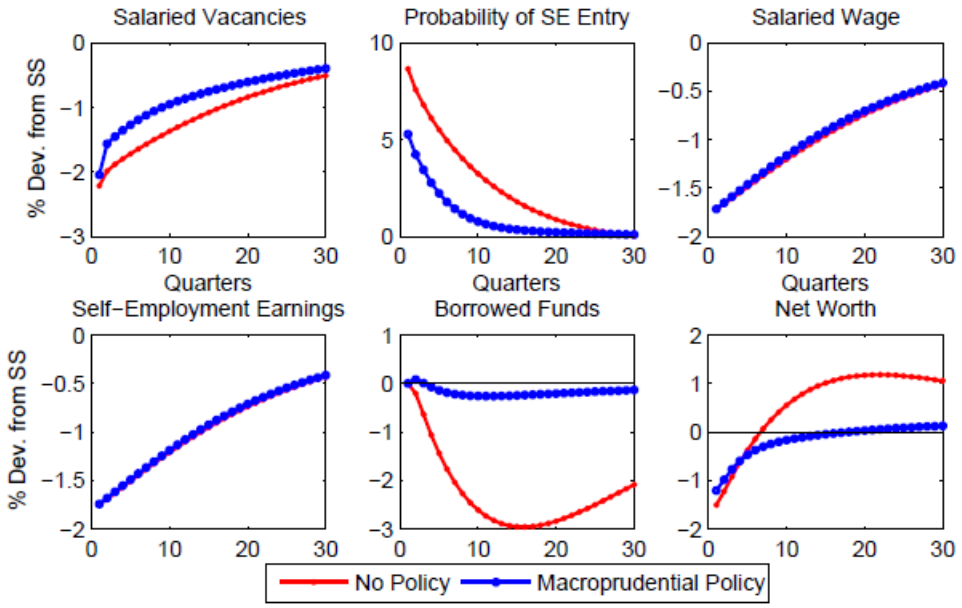


To highlight the importance of the input credit channel for characterizing the employment and aggregate consequences of introducing policies that limit credit fluctuations, we compare our results to a model with exogenous entry into self-employment. In this model, unemployed individuals do not require external inputs to become self-employed and simply transition into self-employment with a fixed probability. The BGG frictions in the salaried sector remain operative.[37] While the behavior of output and net worth in both the no-policy and policy scenarios are similar across models, there are several crucial differences. In the model with exogenous self-employment entry, the fall in investment volatility under the policy is much smaller. Also, the

[37] While the impulse response functions for this model suggest that self-employment expands after a negative productivity shock, the cyclical correlation between self-employment and output is mildly positive. The response of self-employment in the aftermath of the shock is completely driven by unemployment and the fixed transition probability only dictates the sensitivity of self-employment to movements in unemployment.

responses of self-employment and self-employment output are virtually unaffected by the macroprudential policy. A similar claim applies to salaried employment. However, the fact that entry into self-employment is not an explicit decision and does not depend on the availability of resources affects its role as an insurance mechanism against shocks. Interestingly, when the macroprudential policy is active, smaller fluctuations in borrowed funds adversely affect consumption by generating a sharper initial fall in response to the shock. This stands in contrast to the response of consumption in the benchmark model. More importantly, the model with exogenous entry suggests that macroprudential policy generates a mild improvement in the recovery of employment in the aftermath of a negative productivity shock.[38]

Figure 3. Response to a Negative Productivity Shock (Continued)



The main message from this experiment is that the link between labor markets and formal and informal credit markets may be important for a comprehensive assessment of the impact of macroprudential policy on employment and aggregate dynamics. Ignoring the link between small (self-employed) firms and the salaried sector through both labor and credit markets yields an incomplete picture of the policy implications of reducing credit fluctuations in an economy where i) self-employment accounts for a non-negligible share of total employment, and ii) input (or informal) credit is an important force behind changes in the cyclical composition of employment.

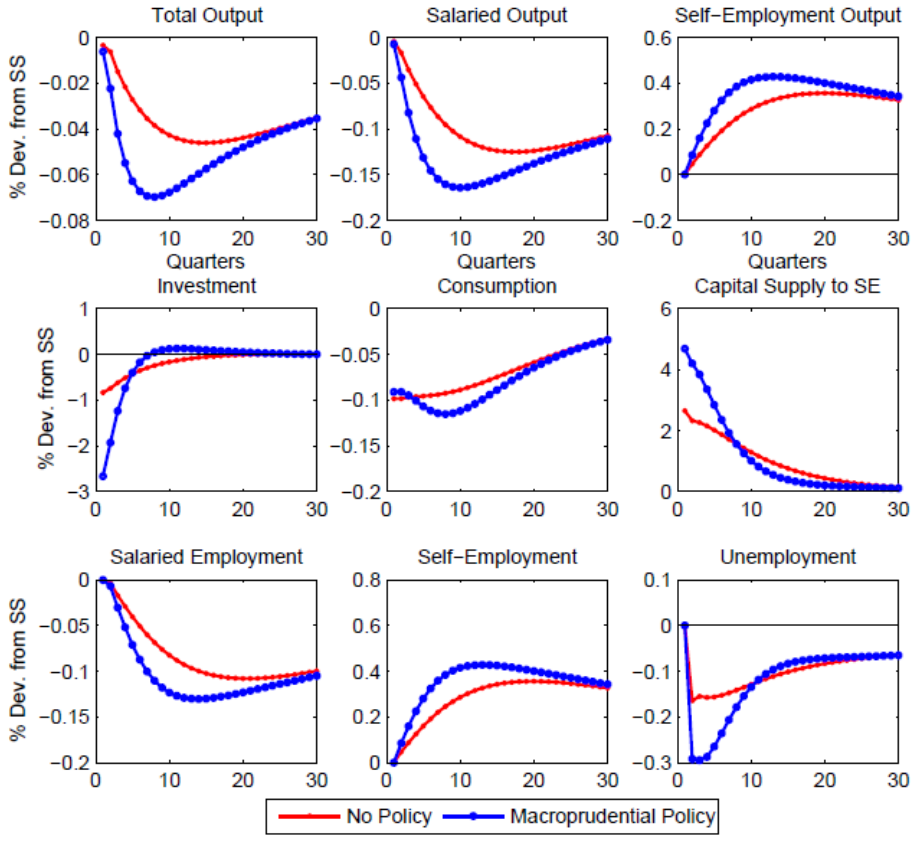
[38] See the Appendix for details.

These findings suggest that, while a well-intentioned macroprudential policy can stabilize particular macro aggregates, it can also generate additional unemployment volatility. Given the presence of weak safety nets in many Latin American economies, an intervention that attempts to reduce credit cycles may then lead to larger welfare losses from adverse shocks through higher labor market and unemployment variability.

4.4 Response to a Negative Net Worth Shock

Figure 4 shows the response of the economy to a negative net worth shock. First, consider the economy without the policy. Given that $b_{S,t} = Q_{G,t}k_{G,t+1} - nw_{S,t+1}$, a negative net worth shock raises the desired amount of borrowed funds and increases the external finance premium. In turn, the demand (and the price) for generic capital by salaried firms falls and generates a contraction in total investment.

Figure 4: Response to a Negative Net Worth Shock



Salaried labor demand and firm-specific capital usage in the salaried sector contract, which all lead to a fall in salaried output. The fall in firm-specific capital usage within the salaried sector increases the availability of capital to potential self-employed individuals. This 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 generates a contraction in consumption. With an active macroprudential policy, the net worth shock generates a sharper response in all variables. The decrease in salaried employment and output, investment, and total output are larger relative to the benchmark economy. Furthermore, the expansions in self-employment and self-employment output are also larger. This takes place because the policy limits the rise in desired borrowed funds, so that salaried firms have a stronger incentive to decrease the use of firm-specific capital and reallocate that idle capital to the self-employed. This generates a larger expansion in the availability of firm-specific capital for self-employment, which subsequently leads to a larger rise in self-employment. This explains the sharper movements in unemployment under the policy. Given that the net worth shock only affects the salaried sector, the macroprudential policy exacerbates the differences between the salaried and self-employment sectors, thereby leading to more pronounced fluctuations relative to the no-policy scenario.

A caveat regarding these results: while a negative net worth shock generates a fall in unemployment in the model, this is due to the fact that search markets for capital do not get disrupted by the shock. If we consider that negative net worth shocks can worsen the efficiency of the matching process between unused firm-specific 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.[39] This is indeed the case when we allow the capital matching efficiency parameter to be correlated with innovations to net worth.

[39] 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 agencies) of the quality of the firms' inputs, or they may face challenges in accessing secondary liquid markets to sell their unused inputs. One way to capture this in a reduced-form way would be through a reduction in matching efficiency in capital markets when net worth falls.

4.5 Summary of Main Results and Intuition

Policy interventions that limit credit fluctuations seem to reduce the persistence of consumption and output contractions and decrease the volatility of investment in response to productivity shocks, while they seem to amplify the response of these variables in response to net worth shocks. However, cyclical macroprudential policy tends to amplify unemployment fluctuations regardless of whether we consider aggregate productivity or net worth shocks. This result can be rationalized by looking at the cyclical behavior of self-employment, which tends to magnify the response of unemployment relative to an environment where macroprudential policy is absent. This is true even though the policy reduces the response of available capital for self-employment after a productivity shock (and increases this capital after a negative net worth shock). Under all scenarios, the macroprudential policy generates sharper and more persistent fluctuations in self-employment, which end up driving the behavior of unemployment. To the best of our knowledge, this result had not been pointed out in existing literature since most studies on the effects of macroprudential policy abstract from labor market dynamics.

These results highlight the need to understand the various channels through which macroprudential policy affects the real economy, and the importance of taking into account the spillover effects across different markets when thinking about policy interventions. This is particularly relevant in an environment where informal credit markets are not only indirectly affected by policies that target formal credit markets, but are also relevant for small firm and employment dynamics. Rather than interpreting our results as suggesting that stabilizing credit fluctuations may not be good policy, we think that they highlight the importance and potential benefits of complementarities between active labor market interventions and policies that reduce the volatility of credit over the business cycle.

4.6 Elasticity of Substitution between Firm-Specific and Generic Capital

The benchmark model assumes that firm-specific capital and generic capital are imperfect substitutes. To determine the sensitivity of the model to the relationship between firm-specific and generic capital, we vary the parameter that determines the elasticity of substitution between the two types of capital and perform the same experiments outlined above. The main results under aggregate productivity shocks remain qualitatively unchanged. In fact, assuming that the two types of capital are closer to being complements makes the results stronger. For example, the change in

the volatility of unemployment as we vary the degree of macroprudential intervention is greater. Thus, our results are robust to different specifications for the relationship between firm-specific capital and generic capital in the model.

4.7 Shocks to the Self-Employment Sector

In response to a negative productivity shock in 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, and also reduces generic capital demand. However, this leads to a contraction in the price of generic 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 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 a smaller contraction in self-employment and output in the sector. The policy puts further downward pressure on the price of generic capital and leads to a larger contraction in investment, driven mainly by the behavior of generic capital investment. Ultimately, the larger drop in investment due to the policy limits the increase in salaried output (due to the rise in salaried employment), and the net result is higher total output volatility.[40] 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.

5. Conclusion

The recent financial crisis stressed the strong connection between financial markets and labor markets, and the importance of financial imperfections for aggregate economic activity in developed countries. As financial development continues to take place in developing countries, it becomes increasingly important to understand the role of financial frictions in these economies. The sustained expansion in credit in several Latin American economies since the mid-2000s poses a number of challenges in the region, and macroprudential policy has been put forth as a flexible

[40] 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.

tool to foster financial and macroeconomic stability. However, the labor market and aggregate consequences of policies that reduce credit fluctuations have not been explored in detail.

We build a small open economy business cycle model with financial frictions and frictional labor markets consistent with the labor and financial market structure in many Latin American economies. In particular, we account for the prevalence of self-employment and its reliance on informal financing, and the interaction between informal credit and formal financial frictions. We use the model to explore the implications of cyclical macroprudential policy for labor market and aggregate dynamics. We contribute to the recent literature on emerging market business cycles and financial frictions on three fronts: i) we introduce a labor market structure in line with with many developing economies in a context where financial frictions prevail, ii) we establish a connection between formal credit imperfections, informal credit frictions, and the labor market, and iii) we analyze the impact of cyclical macroprudential regulations on employment and aggregate dynamics. With few recent exceptions, the labor market in models of financial frictions has been in the background, and this holds particularly true in models for emerging economies. Furthermore, the literature on macroprudential policy has generally abstracted from analyzing employment dynamics.

In our model, salaried firms are subject to financial frictions à la Bernanke, Gertler, and Gilchrist (1999), where they must borrow to purchase capital. They also act as input suppliers to the self-employed via input credit relationships. Households spend resources to find input suppliers in order to obtain capital and send its unemployed members to self-employment. This makes self-employment entry endogenous and frictional, and generates cyclical self-employment dynamics consistent with the data. The link between salaried firms subject to formal financial frictions, informal credit, and self-employment gives rise to a novel channel whereby macroprudential regulations that affect formal credit markets can propagate to the labor market and to the self-employment sector through changes in input credit.

First, we show that the model is consistent with the cyclical dynamics of developing country labor markets, as well as the behavior of leverage, interest rates, and the main macroeconomic aggregates in emerging economies. Second, we find that in response to a negative aggregate productivity shock, macroprudential policy reduces the persistence of consumption, investment, and output contractions, but leads to long-lasting deviations of self-employment from trend, which in turn generate a larger expansion in unemployment. In response to net worth

shocks, the policy generates sharper deviations in all variables. The connection between labor market dynamics, formal financial frictions, and macroprudential policy through the (informal) input credit channel plays a key role in explaining these results. Given the presence of weak safety nets in most Latin American economies, our results carry important policy implications: cyclical macroprudential policies that aim to foster financial and macroeconomic stability can generate sharper self-employment and unemployment fluctuations and offset some of the benefits from less pronounced credit cycles. Our findings also highlight an important transmission channel that has been ignored in the policy debate on macroprudential regulation, mainly informal credit. Rather than downplaying the benefits of macroprudential policy as a stabilization tool, 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 the benefits and costs of macroprudential interventions over the business cycle.

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 conventional monetary policy to provide 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 may yield different conclusions. Finally, we did not explore the complementarity between macroprudential policy and active labor market policies. We plan to explore these and other relevant issues in future work.

References

Adjemian, S. et al. 2011. "Dynare: Reference Manual Version 4." Dynare Working Paper 1. Paris, France: Centre pour la Recherche Economique et ses Applications (CEPREMAP).

Aguiar, M., and G. Gopinath. 2007. "Emerging Market Business Cycles: The Cycle Is the Trend." *Journal of Political Economy* 115(1): 69-102.

Andolfatto, D. 1996. "Business Cycles and Labor-Market Search. " *American Economic Review* 86: 112-132.

Angelini, P., S. Nicoletti-Altimari and I. Visco. 2012. "Macroprudential, Microprudential and Monetary Policies: Conflicts, Complementarities and Trade-Offs." Banca d'Italia Occasional Paper 140. Rome, Italy: Banca d'Italia.

Bartelsman, E., J. Haltiwanger and S. Scarpetta. 2004. "Microeconomic Evidence of Creative Destruction in Industrial and Developing Countries." World Bank Working Paper 3464. Washington, DC, United States: World Bank.

Benigno, G. et al. 2013. "Financial Crises and Macro-Prudential Policies." *Journal of International Economics* 89(2): 453-470.

Bernanke, B.S., M. Gertler and S. Gilchrist. 1999. "The Financial Accelerator in a Quantitative Business Cycle Framework." In: J.B. Taylor and M. Woodford, editors. *Handbook of Macroeconomics*. Volume 1. Amsterdam, The Netherlands: Elsevier.

Bianchi, J., E. Boz and E. Mendoza. "Macroprudential Policy in a Fisherian Model of Financial Innovation." *IMF Economic Review* 60(2): 223-269.

Bosch, M., and W. Maloney. 2006. "Gross Worker Flows in the Presence of Informal Labor Markets: Evidence from Mexico, 1987-2002." IZA Discussion Paper 2864. Bonn, Germany: Institute for the Study of Labor (IZA).

Bosch, M., and W. Maloney. 2008. "Cyclical Movements in Unemployment and Informality in Developing Countries." IZA Discussion Paper 3514. Bonn, Germany: Institute for the Study of Labor (IZA).

Burkart, M., and T. Ellingsen. 2004. "In-Kind Finance: A Theory of Trade Credit." *American Economic Review* 94(3): 569-590.

Burkart, M., T. Ellingsen, and M. Giannetti. 2011. "What You Sell Is What You Lend? Explaining Trade Credit Contracts." *Review of Financial Studies*24(4): 1261-1298.

Calstrom, C.T., and T.S. Fuerst. 1996. “Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis.” Federal Reserve Bank of Cleveland Working Paper 9602. Cleveland, United States: Federal Reserve Bank.

Calstrom, C.T., and T.S. Fuerst. 1997. “Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis.” *American Economic Review* 87(5): 893-910.

Céspedes, L.F., R. Chang and A. Velasco. 2012. “Financial Intermediation, Exchange Rates, and Unconventional Policy in an Open Economy.” NBER Working Paper 18431. Cambridge, United States: National Bureau of Economic Research.

Chavis, L.W., L. Klapper and I. Love. 2011. “The Impact of the Business Environment on Young Firm Financing.” *World Bank Economic Review* 25(3): 486-507.

Christiano, L.J., M. Trabandt and K. Walentin. 2011. “Introducing Financial Frictions and Unemployment in a Small Open Economy Model.” *Journal of Economic Dynamics and Control* 35(12): 1999-2041.

Chugh, S. 2013. “Costly External Finance and Labor Market Dynamics.” *Journal of Economic Dynamics and Control* 37: 2882-2912.

Claessens, S., S.R. Ghosh and R. Mihet. 2013. “Macro-Prudential Policies to Mitigate Financial System Vulnerabilities.” *Journal of International Money and Finance* 39: 153-185.

Cull, R., D. McKenzie and C. Woodruff. 2008. “Experimental Evidence on Returns to Capital and Access to Finance in Mexico.” *World Bank Economic Review* 22(3): 457-482.

De la Torre, A., A. Ize and S.L. Schmukler. 2012. *Financial Development in Latin America and the Caribbean: The Road Ahead*. Washington, DC, United States: World Bank Group.

Demirgüç-Kunt, A., and V. Maksimovic. 2001. “Firms as Financial Intermediaries: Evidence from Trade Credit Data.” Policy Research Working Paper 2696. Washington, DC, United States: World Bank.

Epstein, B., and A. Finkelstein Shapiro. 2014. “Firm and Job Creation Policies during Recessions in Emerging Economies.” Washington, DC, United States and Bogota, Colombia: Federal Reserve Board and Universidad de los Andes. Mimeographed document.

Fernández, A., and A. Gulan. 2014. “Interest Rates and Business Cycles in Emerging Economies: The Role of Financial Frictions.” Forthcoming in *American Economic Journal: Macroeconomics*.

Fernández, A., and J. Herreño. 2013. “Equilibrium Unemployment During Financial Crises.” Working Paper IDB-WP-390. Washington, DC, United States: Inter-American Development Bank.

Fuentes-Albero, C. 2012. “Financial Frictions, Financial Shocks, and Aggregate Volatility,” Dynare Working Paper 18. Paris, France: Centre pour la Recherche Economique et ses Applications (CEPREMAP).

Filiz Unsal, D. 2013. “Capital Flows and Financial Stability: Monetary Policy and Macroprudential Responses.” *International Journal of Central Banking* 9(1): 233-285.

Finkelstein Shapiro, A. 2014. “Self-Employment and Business Cycle Persistence: Does the Composition of Employment Matter for Economic Recoveries?” *Journal of Economic Dynamics and Control* 46: 200–218.

Gal, P.N., and G. Pinter. 2013. “Capital over the Business Cycle: Renting versus Ownership.” Bank of England Working Paper 478. London, United Kingdom: Bank of England.

Galindo, A., and F. Schiantarelli. 2002. “Credit Constraints in Latin America: An Overview of the Micro Evidence.” Research Network Working Paper R-472. Washington, DC, United States: Inter-American Development Bank.

Gertler, M., S. Gilchrist and F. M. Natalucci. 2007. “External Constraints on Monetary Policy and the Financial Accelerator.” *Journal of Money, Credit and Banking* 39(2-3): 295-330.

Gilchrist, S., and E. Zakrajšek. 2011. “Monetary Policy and Credit Supply Shocks.” *IMF Economic Review* 59: 195-232.

González, A., F. Hamann and D. Rodríguez. 2013. “Macroprudential Policies in a Commodity Exporting Economy.” Bogota, Colombia: Universidad de los Andes and Banco de la República. Mimeographed document.

Harbo Hansen, N-J., and O. Sulla. 2013. “Credit Growth in Latin America: Financial Development or Credit Boom?” IMF Working Paper WP/13/106. Washington, DC, United States: International Monetary Fund.

Inter-American Development Bank. 2005a. *Unlocking Credit: The Quest for Deep and Stable Bank Lending*. Washington, DC, United States: Inter-American Development Bank. Available at: http://www.iadb.org/res/ipes/2005/index.cfm.

Jácome, L.I., E.W. Nier and P. Imam. 2012. “Building Blocks for Effective Macroprudential Policies in Latin America: Institutional Considerations.” IMF Working Paper WP/12/183. Washington, DC, United States: International Monetary Fund.

Kantis, H., P. Angelelli and V. Moori Koenig, editors. 2005. Developing Entrepreneurship: Experience in Latin America and Worldwide. Washington, DC, United States: Inter-American Development Bank. Available at: http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=834797.

Kiley, M.T., and J.W. Sim. 2012. “Intermediary Leverage, Macroeconomic Dynamics, and Macroprudential Policy.” Mimeographed document.

Klapper, L.F., and D. Randall. 2011. “Financial Crisis and Supply-Chain Financing.” In: J-P. Chauffour and M. Malouche, editors. Trade Finance During the Great Trade Collapse. Washington, DC, United States: World Bank.

Krause, M., and T. Lubik. 2010. “On-the-Job Search and the Cyclical Dynamics of the Labor Market.” Federal Reserve Bank of Richmond Working Paper WP 10-12. Richmond, United States: Federal Reserve Bank.

Levy, S. 2007. “Can Social Programs Reduce Productivity and Growth? A Hypothesis for Mexico.” IPC Working Paper 37. Ann Arbor, United States: University of Michigan, Gerald R. Ford School of Public Policy.

Love, I., L.A. Preve and V. Sarria-Allende. 2007. “Trade Credit and Bank Credit: Evidence from Recent Financial Crises.” *Journal of Financial Economics* 83(2): 453-469.

McKenzie, D.J.., and C. Woodruff. 2006. “Do Entry Costs Provide an Empirical Basis for Poverty Traps? Evidence from Mexican Microenterprises.” *Economic Development and Cultural Change* 55(1): 3-42.

Mumtaz, H., and F. Zanetti. 2011. “Labor and Financial Frictions and Aggregate Fluctuations.” London, United Kingdom: Bank of England. Mimeographed document.

Organisation for Economic Co-operation and Development (OECD). 2012. : *SME Policies for Structural Change*. Latin American Economic Outlook 2013. Paris, France: OECD. Available at: http://dx.doi.org/10.1787/leo-2013-en.

Perry, G. et al. 2007. *Informality: Exit and Exclusion*. Washington, DC, United States: World Bank. Available at: https://openknowledge.worldbank.org/handle/10986/6730

Pratap, S., and C. Urrutia. 2007. “Credit Constraints, Firm Dynamics, and the Transmission of External Financial Shocks.” Mimeographed document.

Raddatz, C. 2010. “Credit Chains and Sectoral Comovement: Does the Use of Trade Credit Amplify Sectoral Shocks?” *Review of Economics and Statistics* 92(4): 985-1003.

Schmitt-Grohé, S., and M. Uribe. 2003. “Closing Small Open Economy Models.” *Journal of International Economics* 61(1): 163-185.

Suh, H. 2012. “Macroprudential Policy: Its Effects and Relationship to Monetary Policy.” Bloomington, United States: Indiana University. Mimeographed document.

Varela, L. 2013. “Sector Heterogeneity and Credit Market Imperfections in Emerging Markets.” Paris, France: Paris School of Economics. Mimeographed document.

World Bank. 2012. *World Development Report 2013: Jobs*. Washington, DC, United States: World Bank.

World Bank. 2014. *Financial Inclusion*. Global Financial Development Report. Washington, DC, United States: World Bank.

World Bank. Various dates. Enterprise Surveys. Washington, DC, United States: World Bank. Available at: http://www.enterprisesurveys.org.

Zhang, Y. 2012. “Financial Shocks, Two Sector Labour Markets, and Unemployment.” Ottawa, Canada: Bank of Canada. Mimeographed document.

Appendix

Calibration of Model with Productivity and Net Worth Shocks

The first-moment targets remain the same as in the benchmark calibration with only productivity shocks. The targets for the firm-specific capital and generic capital investment adjustment costs, and for the persistence and volatility of the aggregate productivity and financial shocks are the relative volatility of consumption and total investment, 1.13 and 2.78, respectively, the volatility of total output, 2.39, the cyclical correlation of self-employment, -0.45, the cyclical correlation of total employment, 0.53, the contemporaneous correlation between interest rates and output, -0.35, and the contemporaneous correlation of leverage and output, -0.30.[41]

Table 7. Calibrated Parameters and Targets: Economy with Correlated Shocks

Parameter	Value	Parameter Description	Target
b^*	1.097	SS Foreign Debt	$b^*/y = 0.10$
M_S	0.183	Sal. Match. Efficiency	$n_S = 0.72$
M_{SE}	0.057	SE Match. Efficiency	$n_{SE} = 0.23$
ν_G	0.066	EFP Elasticity	Lev. Ratio of 1.73
φ_v	0.069	Fraction of nw_S , Exiting Firms	1 percent of wages
ψ_S	0.035	Salaried Vacancy Cost	3.5 percent of wages
ψ_{SE}	1.008	Project Posting Cost	3 months of wages
ξ_S	0.341	Share of Firm-Specific k	$(i_T/i) = 0.64$
η_b	0.100	Elasticity of Foreign Debt	See Text
ρ_z	0.940	Autocorrelation of TFP	See Text
σ_z	0.017	Standard Dev. of TFP	See Text
ρ_{znw}	0.200	Autocorrelation of υ_G	See Text
σ_{znw}	0.010	Standard Dev. of υ_G	See Text
ψ_{kG}	6.100	Adjustment Cost, i_G	See Text
ψ_{kS}	4.000	Adjustment Cost, k_T	See Text
$corr(\sigma_z,\sigma_{znw})$	0.300	Correlation of Shocks	See Text

[41] 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 targets for the interest rate and leverage are from Fernández and Gulan (2014).

Model with Exogenous Self-Employment Entry and No Input Credit Channel: Productivity Shocks

Figure 5. Response to a Negative Aggregate Productivity Shock: No Input Credit Channel