BANK OF CANADA
BANQUE DU CANADA

Working Paper/Document de travail
2014-35

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Bank of Canada Working Paper 2014-35

August 2014

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by

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ISSN 1701-9397

Acknowledgements

We would like to thank Ron Alquist, Michael Ehrmann, Yuko Imura, and seminar participants at the Bank of Canada, Conference on Computing in Economics and Finance 2013, Midwest Macro Meetings 2013, and Conference for the Canadian Economic Association 2012.

Abstract

This paper examines the role of the extensive and intensive margins of labour input in the context of a business cycle model with a financial friction. We document significant variation in the hours worked per worker for many emerging-market economies. Both employment and hours worked per worker are positively correlated with each other and with output. We show that a search-theoretic context in a small open-economy model requires a small income effect to explain these regularities at the expense of a smaller wage response. On the other hand, introducing a financial friction in the form of a working capital requirement can explain the observed movements of labour market variables such as employment and hours worked per worker, as well as other distinguishable business cycle characteristics of emerging economies. These include highly volatile and cyclical real wages, labour share, and consumption.

JEL classification: F41, E44, J40
Bank classification: Business fluctuations and cycles; Labour markets; Development economics; International topics; Interest rates

Résumé

Dans cette étude, les auteurs se penchent sur le rôle joué par les marges extensive et intensive du travail dans le cadre d'un modèle du cycle économique incorporant une friction financière. Ils mettent en évidence des variations significatives des heures travaillées par ouvrier parmi de nombreux marchés émergents. Ils constatent, en outre, que l'emploi et les heures travaillées par ouvrier sont corrélés positivement entre eux, de même qu'avec la production. Ils montrent qu'un modèle intégrant des frictions d'appariement sur le marché du travail dans une petite économie ouverte ne peut expliquer ces régularités que lorsque l'effet de revenu est modéré, impliquant une faible réaction des salaires. Par ailleurs, l'introduction d'une friction financière, sous la forme d'exigences de fonds de roulement, permet au modèle d'expliquer les mouvements observés de variables du marché du travail comme l'emploi et les heures travaillées par ouvrier, ainsi que d'autres aspects particuliers du cycle économique dans les économies émergentes, tels que la cyclicité et la forte volatilité des salaires réels, de la part du travail et de la consommation.

Classification JEL : F41, E44, J40
Classification de la Banque : Cycles et fluctuations économiques; Marchés du travail; Économie du développement; Questions internationales; Taux d'intérêt

1 Introduction

A number of recent papers have drawn attention to the stylized facts of business cycles in emerging-market economies. In such economies, consumption is more volatile than output, and net exports are strongly countercyclical. This is in contrast to business cycles in developed markets, where consumption is less volatile than output and net exports are slightly countercyclical. Among other papers, Aguiar and Gopinath (2007) attempt to reconcile these findings in the context of a small open-economy real business cycle model (SOE-RBC). They argue that, for emerging markets, the cycle is the trend in that fluctuations in trend productivity can account for many of the business cycle features. Neumeyer and Perri (2005) introduce financial or interest rate shocks that propagate in emerging economies through a working capital requirement.

Another difference between developed and emerging-economy business cycles has to do with the behaviour of labour market variables. In contrast to developed markets, wages are highly volatile and procyclical in emerging markets, as is the labour share. In order to account for those labour market patterns, Boz et al. (2009) examine a model with search and matching frictions under one endogenous margin of labour input, namely employment. Also, Li (2011) and Kabaca (2011) seek to rationalize the movements in wages and labour share with financial frictions in a Walrasian labour market set-up.

In this paper, we examine the implications of SOE-RBC models that allow for variation in both extensive and intensive margins in the labour input. Our model incorporates a financial friction in the form of a working capital constraint (which stipulates payments in advance for the labour input in production) and search-and-matching frictions in the labour market. The financial friction is motivated by the fact that most firms in emerging economies finance current operating costs through short-term bank credit.[1] In our framework, a search-and-matching friction accounts for fluctuations in the extensive margin of work, while Nash bargaining between workers and firms accounts for variation in the intensive margin along with wages.[2] By combining financial frictions with search frictions in a more realistic framework, we seek to understand the nature of labour market fluctuations in emerging-market economies.

Our motivation for examining the different margins of labour input stems from the significant variation observed not only in employment but also hours (worked) per worker in emerging markets, as documented in section 2. Furthermore, we show that both hours per worker and employment are procyclical with output and positively correlated with each other in emerging economies. These labour market properties are dissimilar to those in developed markets. Hours per worker is less cyclical with output and not significantly

[1] See Fan et al. (2012) for the importance of short-term debt in emerging economies.

[2] Poyraz (2009) also considers a model with interest rate shocks and labour market search, but she does not allow for variation in the intensive margin of work.

correlated with employment in developed markets.

While changes in employment have been examined in the context of search models for emerging economies, previous work has essentially ignored changes in the intensive margin. Our findings suggest that once we allow for an endogenous intensive margin, a search-theoretic framework cannot reconcile business cycle puzzles for emerging economies. This is due to a strong income effect on hours worked, which tends to move the supply of labour in the same direction as interest rates, thereby generating results for hours and consumption that are inconsistent with the data. These results improve somewhat when we utilize alternative forms of preferences that imply a smaller income effect (see Jaimovich and Rebelo, 2009), but still do not match data moments. In addition, this improvement comes at the expense of a smaller wage response. It is by allowing for financial frictions in the form of a working capital requirement that we can explain both wage and labour input responses. Specifically, the working capital requirement tends to amplify the impact of interest rates that work through labour demand, in that a higher interest rate makes recruiting and employing more costly and, therefore, depresses the demand for labour and reduces both margins of labour input as well as wages. Thus, there are interactions arising from financial and search frictions in SOE-RBC models that jointly rationalize the observed responses of the labour market outcomes.

Our paper is related to the literature that previously studied the role of search frictions on aggregate fluctuations in developed markets. Andolfatto (1996) and Merz (1995) show that these types of frictions have an amplification effect on labour market variables in closed-economy business cycle models. Hairault (2002) considers the case of two large open economies with search and matching frictions. In a recent paper, Petrosky-Nadeau (2011) combines search frictions with credit imperfections and shows that, in a developed market, the incentive to hire during a credit tightening is lower given the same benefit to the worker.[3]

There are also studies that have differentiated between the intensive and extensive margins in the context of search models for developed economies. Yedid-Levi (2009) and Merkl and Wesselbaum (2011) show that hours per worker is a secondary source of variation in developed economies. Yedid-Levi (2009) further argues that differentiating the margins of labour is an essential step for understanding the co-movement across sectors in a model with search-and-matching frictions. In a different vein, using a time-varying vector autoregression framework, Seymen (2011) examines the role of the extensive versus intensive margins of work in the United States and Germany so as to explain the adjustment to cyclical shocks. One potential source of different variations in these margins may arise from the role of labour market regulations. Studies such as Burdett and Wright (1989) show that different unemployment compensation schemes may also lead to differential responses

[3]We do not introduce imperfect credit in this chapter in order to concentrate on the interaction between search and short-term credit, namely, working capital loans.

in employment versus hours per worker.[4] In section 2, we discuss the labour regulation in emerging markets using the data set constructed by Botero et al. (2004), and show that despite their regulatory resemblance with European countries, the movements of labour margins differ from those in Europe. For this reason, instead of concentrating on differences in the institutional frameworks, we study the effects of alternative financial frictions that emerging markets may face - such as the need for short-term credit and the higher cost of borrowing during recessions - when seeking to understand the cyclical movements in the intensive and extensive margins of labour inputs.

The rest of the paper is organized as follows. Section 2 documents the volatility and correlation statistics for employment and hours per worker in emerging markets. For comparison, the stylized facts on labour market fluctuations in developed markets are also included here. Section 3 presents the model with both search and financial frictions. Section 4 describes the calibration strategy, discusses the main findings of the model, and performs robustness analyses to parameter changes. Section 5 concludes.

2 Variation in the Intensive and Extensive Margins of Work

In this section, we present some evidence regarding variations in the intensive and extensive margins of labour input for emerging and developed economies. We have data, mostly over the period 1981-2008, on both margins of labour input in manufacturing for a set of emerging and developed markets. Emerging markets are defined as the countries included in the emerging-market indices released by institutions providing investment analysis such as JP Morgan, MSCI and FTSE. These countries are known to have riskier assets and countercyclical interest rates. We exclude those countries that do not publish data on hours per worker or for which we have less than ten annual observations. The data on hours come from industrial surveys in emerging-market economies.[5] Hours represent actual hours worked in these surveys, which is consistent with both national accounts in these economies and the OECD data for developed economies. Since the data come from the manufacturing sector for emerging markets, we also use manufacturing data for developed markets. Data description and sources are provided in the appendix.

[4] Specifically, a scheme that allows for partial compensation when hours are reduced - as practiced by many European economies - may yield larger variations in the intensive margin relative to a U.S.-type scheme in which workers are compensated conditional on being employed or not.

[5] Some countries report household/labour survey results for the overall economy (see the International Labour Organization website for this); however, they are often not comparable across countries and over time. To give a few examples: (i) many countries report hours paid or normal (usual) hours rather than those worked, (ii) some conduct these types of surveys in only one month during the year, (iii) labour surveys include many break points, which makes it difficult to calculate cyclical components around these points, and (iv) workers surveyed tend to report overwork (see Mellow and Sider, 1983), which is potentially more problematic during recessions, when hours might be cut. This is why we choose to work on industrial (establishment) surveys in manufacturing.

Table 1 shows the standard deviation of employment and hours per worker relative to the standard deviation of real output, the correlation of output with employment and hours per worker, and the correlation of employment and hours per worker in both emerging and developed economies. One finding from Table 1 is that both margins of work significantly move over the cycle for both groups of countries. In the developed economies, the variability of employment relative to that of GDP is somewhat greater than the variability of hours per worker relative to that of GDP, albeit not significantly. The average value of the relative standard deviation of employment is 0.89 versus 0.75 for hours per worker in developed economies. However, it is hard to say that hours per worker contributes less to the variability of total hours in emerging economies. The average value of the relative standard deviation in employment is 0.59 versus 0.65 for hours per worker in emerging economies.[6] This suggests that the hours per worker in emerging economies exhibits as much variation as employment. This is why we will let the intensive margin of work vary over the cycle in the model.[7,8]

A second finding from Table 1 is the significantly higher correlation of detrended real GDP with hours per worker for the emerging economies. We observe that this quantity is nearly twice as large as that in developed economies (0.49 vs. 0.26). Especially the countries where we have observed large financial shocks and financial crises since the 1980s, such as Argentina, Korea, Mexico and Turkey, significantly contribute to this difference.[9]

A third finding from Table 1 is that the correlation between employment and hours per worker is also positive in emerging economies, and much larger than that for the developed economies (0.46 vs. -0.09). By contrast, there is a negative correlation between employment and hours per worker for many of the European economies, such as Austria, Denmark, France, Germany, Norway and Sweden.[10] Thus, both margins tend to move together for

[6] At the 95% and 90% level of significance, we cannot reject a hypothesis that hours per worker is as volatile as employment in emerging markets, where the alternative is that hours per worker is less volatile than employment.

[7] Note that the volatility of the intensive margin might be even higher than presented here for both groups when we allow for labour utilization, since the effort that each worker puts in during recessions may be lower than in boom times. On the other hand, this could be offset by the potential upward bias coming from the use of data on manufacturing, which tends to be more volatile than the aggregate economy. Nevertheless, these results still justify a model in which the intensive margin varies endogenously, rather than a model in which it is assumed fixed.

[8] One would also notice a significant difference in employment volatility across country groups. In emerging markets, employment tends to be less volatile than in advanced economies. We note that the number of self-employed such as farmers in emerging markets do not vary as much as the number of salaried employees. Since self-employment constitutes about 30% of the total employment on average in emerging markets, it significantly affects the variation of the total employment. When only employees are considered, the standard deviation of employment increases by around 40%, but its correlations with output and hours per worker do not change much. These results can be obtained from the authors upon request.

[9] For the case of Argentina and Mexico, the sample period includes the Tequila crisis of 1995 as well as the contagious effects of the 1998 Russian crisis. Moreover, Argentina experienced the sovereign debt default of 2002. For Turkey, there are two major financial crises, the 1994 exchange rate crisis and the 2000-2001 banking and financial crisis. For a further discussion of the timing of the recessions associated with such crises, see Altug and Bildirici (2012).

[10] As discussed in the Introduction, one reason for the negative correlation between employment and hours

emerging markets, whereas that is not the case for developed markets. These results suggest that the dynamics of labour markets in emerging economies may differ in significant ways from those of developed ones. The difference still remains when we take into account institutional comparisons. Botero et al. (2004) present a data set on employment protection laws across countries. In this data set, the average employment protection index for emerging economies lies between those for European and Anglo-Saxon economies.[11] Yet, emerging economies show even stronger co-movement between hours per worker and employment than the Anglo-Saxon countries such as Canada and the United States in our sample (see Table 1). That is why we focus on differences in financial markets and interest rates rather than differences in the institutional environment.

One of the features during periods of fallen output in emerging markets is that these countries tended to experience difficulties in financing their external balances. Increases in sovereign risk lowered their ability to borrow. Table 2 documents correlations between the risk premia (spreads) over U.S. rates, on the one hand, and employment and hours per worker, on the other, for emerging economies. It shows that both employment and hours per worker also have strong cyclical responses when spreads are considered rather than output. Therefore, a model that stresses the importance of financial shocks on employment and hours per worker should be able to explain these movements, as well.

3 Model

This section describes a standard small open-economy real business cycle (SOE-RBC) model with shocks to total factor productivity (TFP) and interest rates modified to incorporate both search and financial frictions. We use a Mortensen-Pissarides type of search-and-matching framework that models employment, unfilled job vacancies and wage determination explicitly. In the light of the above discussion, we also incorporate into the model a financial friction, namely, a working capital requirement, which requires the firm to pay a fraction of labour costs in advance. Moreover, the only asset traded in international financial markets is a non-state-contingent real bond. Households trade in this asset for saving purposes, while firms make use of it for their financing needs.

3.1 The Firm's Problem

A continuum of a large number of competitive firms produce a single tradable good at a world-determined price, which is normalized to one. Output is produced by a constant-returns-to-scale production function: $y_t = A_t k_t^{\zeta} (n_t l_t)^{1-\zeta}$. For the inputs of production,

per worker in European economies may be the existence of employment protection laws.

[11]The average employment protection index is 0.45 in emerging markets, a value that is between the average index for the United States and Canada (0.24) and that for European countries (0.67).

firms hire labour in the form of the number of workers, n_t, as well as hours per worker, l_t, and rent capital, k_t, from households. As opposed to past applications of the search framework for emerging economies (see Boz et al., 2009), we allow the intensive margin of the labour input, l_t, to vary over time and to be chosen as an outcome of a Nash bargaining problem, the details of which will be given in section 3.3.

There are search frictions in the labour market: firms post a job vacancy, v_t, and pay a recruiting cost, κ, for each vacancy every period. New matches are formed according to the matching technology, which is a function of posted vacancies and the non-working population at the beginning of the period: $M(v_t, u_t) = \omega v_t^{\alpha} u_t^{1-\alpha}$ where $u_t = 1-(1-\psi)n_{t-1}$.

The individual firm faces a market-driven job-filling rate given during the recruiting process. We denote the job-filling rate by $\Psi(\theta_t) = \frac{M(v_t,u_t)}{v_t}$, where $\theta_t = \frac{v_t}{u_t}$ is a measure of market tightness, and assume that there is an exogenous separation rate between workers and jobs, ψ. Then, employment evolves according to the following law of motion: $n_t = (1-\psi)n_{t-1} + \Psi(\theta_t)v_t$. This law of motion suggests that a vacancy can be filled and the worker can be productive in the same period.

Along with the labour market friction, firms are also subject to a working capital requirement. They need to acquire working capital loans to pay a fraction of their wage bill and recruitment cost before output is available, and in order to do so they borrow from abroad at the beginning of the period.[12] This type of friction is widely used in macroeconomic papers, since labour costs are an important item in the firms' operating expenses, as opposed to capital payments (business profits) to households.[13] The fraction of the labour cost that has to be paid in advance is denoted by ϕ. Finally, firms use the same stochastic discount factor as households for the present value of future profits, which is $\Pi_{t,t+1} = \beta u_{c,t+1}/u_{c,t}$ where u_c is the marginal utility of consumption, the details of which are given in the next section.

Given the wage rate, w_t, employment, n_{t-1}, and labour supplied per worker, l_t, an individual firm chooses how many vacancies to post, v_t, and how much capital to rent, k_t, and solves the following dynamic problem:

$$\begin{aligned} V^F(n_{t-1}, \epsilon_t) = \max_{v_t,k_t} \quad & \{y_t - (1+\phi(R_{t-1}-1))(w_t n_t l_t + \kappa v_t) - r_t k_t \\ & + E_t \Pi_{t,t+1} V^F(n_t, \epsilon_{t+1})\} \\ s.t. \quad n_t = (1-\psi)n_{t-1} + \Psi(\theta_t)v_t, & \end{aligned} \tag{1}$$

where r_t is the rental payment to households and $\epsilon_t = [A_t, R_t]$ is the exogenous state space, namely, the current values of total factor productivity, A_t, and the interest rate, R_t, on

[12] This could be considered as the equivalent version of having to pay labour costs before the sales are cashed out in an economy where there is a lag between production and cashing out the sales.

[13] See Christiano and Eichenbaum (1992) and Neumeyer and Perri (2005) for the macro implications of this type of friction. Here, we include the recruitment cost in working capital loans as well.

the internationally traded bond. Following Neumeyer and Perri (2005), firms pay R_{t-1} as interest for working capital loans that are borrowed at the beginning of the period before consumption and investment decisions are made.[14]

The optimality condition for vacancies is

$$(1+\phi(R_{t-1}-1))\frac{\kappa}{\Psi(\theta_t)} = \frac{\partial y_t}{\partial n_t} - (1+\phi(R_{t-1}-1))w_t l_t + E_t\left(\Pi_{t,t+1}\frac{\partial V^F_{t+1}}{\partial n_t}\right), \tag{2}$$

where $V^F_{t+1} \equiv V^F(n_t, \epsilon_{t+1})$. Firms choose the number of vacancies such that the cost of posting an additional vacancy equals the value of filling an additional vacancy conditional on the vacancy being filled, where the latter phenomenon occurs with a probability of $\Psi(\theta)$. The value of filling an additional vacancy is equal to the marginal product of one more worker, $\frac{\partial y_t}{\partial n_t}$, minus the labour costs including the interest payments on working capital plus the asset value of the additional worker in the next period.

Next, we write down the envelope condition with respect to n_{t-1}:

$$\frac{\partial V^F_t}{\partial n_{t-1}} = \left(\frac{\partial y_t}{\partial n_t} - (1+\phi(R_{t-1}-1))w_t l_t + E_t\Pi_{t,t+1}\frac{\partial V^F_{t+1}}{\partial n_t}\right)(1-\psi) \tag{3}$$

$$= \frac{(1+\phi(R_{t-1}-1))\kappa}{\Psi(\theta_t)}(1-\psi). \tag{4}$$

Forwarding equation (4) by one period and substituting it into equation (2) yields

$$\frac{(1+\phi(R_{t-1}-1))\kappa}{\Psi(\theta_t)} = \frac{\partial y_t}{\partial n_t} - (1+\phi(R_{t-1}-1))w_t l_t + (1-\psi)E_t\Pi_{t,t+1}\frac{(1+\phi(R_t-1))\kappa}{\Psi(\theta_{t+1})}. \tag{5}$$

Finally, for the purpose of bargaining in later processes, we define V^F_n, the value of an additional worker at time t after new workers have joined the firm. Differentiating $V^F_t(n_{t-1}, \epsilon_t)$ with respect to n_t while taking vacancies as given, we obtain

$$V^F_n \equiv \frac{\partial V^F_t}{\partial n_t} = \frac{\partial y_t}{\partial n_t} - (1+\phi(R_{t-1}-1))w_t l_t + E_t\Pi_{t,t+1}\frac{\partial V^F_{t+1}}{\partial n_{t+1}}(1-\psi). \tag{6}$$

Additionally, the first-order condition with respect to capital is

$$r_t = A_t\zeta k_t^{\zeta-1}(n_t l_t)^{1-\zeta} = \zeta\frac{y_t}{k_t}. \tag{7}$$

This condition is standard and states that firms borrow capital from households to the extent that the marginal product of capital is equal to the rental rate on capital.

[14]Using the current interest rate, R_t, does not change the results, since the interest rate is persistent.

3.2 The Household's Problem

The economy is populated with identical and infinitely lived households on the interval $[0,1]$. Each household is considered as an extended family that contains a continuum of family members endowed with one unit of time. Each member derives utility from consumption c_t and leisure $1-l_t$ where the total time that is devoted to labour and leisure is normalized to one. Members in this family either work and supply l_t amount of labour or stay unemployed. Employed members earn w_t per hour, which is determined by Nash bargaining along with the amount of working hours.

The utility function for each member is assumed to be twice-continuously-differentiable and concave in consumption and leisure, and exhibits a constant relative risk aversion. Here, we explore the effects of both separable and non-separable preferences in terms of consumption and leisure. The aggregate utilities for this family-household are

$$\textit{Separable Preferences (SP)}: u(.) = U(c_t) + n_t\varphi^e H(1-l_t) + (1-n_t)\varphi^u H(1)$$
$$\textit{Jaimovich-Rebelo Preferences (JR)}: u(.) = n_t U(c_t^e - G(x_t, l_t)) + (1-n_t)U(c_t^u),$$

where $U(c_t) = \frac{c^{1-\sigma}}{1-\sigma}$ and $H(l) = \frac{(1-l)^{1-\nu}}{1-\nu}$ are the utility derived from consumption and leisure, respectively, and $\sigma > 0$ is the inverse of the elasticity of intertemporal substitution. Parameters, φ^e and φ^u, govern the utility derived from leisure relative to that from consumption when the member is employed and unemployed, respectively. We assume perfect risk sharing against unemployment, meaning that all family members pool their income and face the same prices for contingent consumption. This implies that the marginal utility in consumption is equated across employed and unemployed family members, which in turn implies equal consumption levels for both employed and unemployed members in the case of separable preferences.

In addition to the standard separable preferences mostly used in search papers, we wish to evaluate results from Jaimovich-Rebelo (JR) preferences as well. These preferences are non-separable across consumption and leisure: $U(c_t^e - G(x_t, l_t)) = \frac{(c_t^e - \varphi^e l_t^\eta x_t)^{1-\sigma} - 1}{1-\sigma}$, $\eta > 1$, $\varphi^e > 0$ if the family member is employed.[15] The second term in the utility function, $G(x_t, l_t)$, expresses the disutility of labour, which is a twice-continuously-differentiable and convex function in hours per worker. In addition, $x_t = c_t^{e^\gamma} x_{t-1}^{1-\gamma}$ determines the strength of the income effect on labour decisions depending on the parameter γ. Note that when $\gamma = 0$ these preferences show the same characteristics as in preferences discussed in Greenwood, Hercowitz and Huffman (1988), which are known as GHH preferences. These types of preferences eliminate the income effect on the labour supply. They are very common in the literature, since they tend to generate more realistic labour movements in open economies.[16]

[15] Note that consumption levels across employed and unemployed members do not necessarily have to be the same under JR preferences.

[16] See, for example, Devereux, Gregory and Smith (1992) and Hairault (2002).

The issue is more crucial for emerging economies where we observe high volatility in interest rates, having a potential to produce larger wealth effects on the labour supply.[17] This is why we analyze the model here under two different preferences. Lastly, the utility function for the unemployed member is assumed to be $U(c_t^u) = \frac{(c_t^u)^{1-\sigma}-1}{1-\sigma}$ following $G(x_t, 0)$=0 for the unemployed.

Households, in the model, also supply capital to firms, k_t, at a rental rate r_t^k. In addition to labour and capital income, they earn interest from the previous period's savings, $R_{t-1}b_{t-1}$, and get dividends from firms, π_t. Given the wage rate, w_t, rental rate of capital, r_t, hours per worker, l_t, previous period of employment, n_{t-1}, interest rate on the bond, R_{t-1}, and probability of finding a job, Ω_t, the household chooses consumption, c_t, investment, i_t, and bond holdings, b_t, to solve the following dynamic problem if preferences are separable:

$$V^H(k_t, b_{t-1}, n_{t-1}, \epsilon_t) = \max_{c_t, i_t, b_t} \quad u(.) + \beta E_t V^H(k_{t+1}, b_t, n_t, \epsilon_{t+1})$$

$$s.t. \qquad c_t + i_t + b_t + \Phi(b_t) = n_t w_t l_t + r_t^k k_t + R_{t-1}b_{t-1} + \pi_t \tag{8}$$

$$i_t = k_{t+1} - (1-\delta)k_t + \Phi(k_{t+1}, k_t) \tag{9}$$

$$n_t = (1-\psi)n_{t-1} + \Omega(\theta_t)u_t,$$

where $\Omega(\theta_t) \equiv \frac{M(.)}{u_t}$ denotes the probability of finding a job. Quadratic convex cost functions, $\Phi(.)$ and $\Theta(.)$, make bond holdings and adjustments in investment costly. These are standard in SOE-RBC studies to make sure that the model exhibits stationary properties, particularly to solve the unit-root problem for bond holdings and to prevent excessive investment.[18] Lastly, the capital stock depreciates at the rate of δ every period.

In the case of JR preferences, the household solves a similar problem except that the budget constraint must be modified to separately account for the consumption of the employed and unemployed family members. The modified budget constraint can be written as

$$n_t c_t^e + (1-n_t)c_t^u + i_t + b_t + \Phi(b_t) = n_t w_t l_t + r_t^k k_t + R_{t-1}b_{t-1} + \pi_t. \tag{10}$$

Furthermore, the agent now chooses the optimal x_t subject to an additional equality constraint as $x_t = c_t^{e^\gamma} x_{t-1}^{1-\gamma}$.

For bargaining purposes, we obtain the value of an additional worker to the household after new workers are matched, depending on the type of preferences, as

$$V_n^H \equiv \frac{\partial V_t^H}{\partial n_t} = \begin{cases} (u_t^e - u_t^u) + \lambda_t w_t l_t + \beta E_t \frac{\partial V_{t+1}^H}{\partial n_{t+1}}(1-\psi)(1-\Omega(\theta_t)) & (SP) \\ (u_t^e - u_t^u) + \lambda_t [w_t l_t - c_t^e + c_t^u] + \beta E_t \frac{\partial V_{t+1}^H}{\partial n_{t+1}}(1-\psi)(1-\Omega(\theta_t)), & (JR) \end{cases} \tag{11}$$

[17]See Neumeyer and Perri (2005), Mendoza (2010), and Li (2011) for further discussions on the wealth effect.

[18]See Schmitt-Grohe and Uribe (2003) for more details.

where u_t^e and u_t^u denote the utilities for employed and unemployed family members, respectively, and λ_t represents the marginal utility of consumption of a family member. For both the separable and non-separable cases, the first term illustrates the net utility loss from being unemployed relative to being employed, conditional on the level of consumption. The second term differs depending on the nature of preferences: in the separable case, the second term shows the marginal value of being employed in terms of the value of wage payments. By contrast, in the non-separable case, the additional term reflects the idea that when a family member becomes employed, the member is entitled to a different amount of consumption and, hence, there is an expenditure difference on consumption (see, for example, Hall and Milgrom, 2008). Finally, the last term is the discounted expected marginal value of future employment, where the weighting factor reflects the probability of still being employed in the next period, $1 - \psi$, as well as the probability of finding a job when separation occurs, $\psi\Omega(\theta_t)$, plus the opportunity cost of taking up employment, $\Omega(\theta_t)$. In the next section, we derive the solution to the Nash bargaining problem between the household and the firm, which is based on their relative valuations of additional employment shown in equations (6) and (11).

The solution to the household's problem also yields the Euler equations for the optimal bond holdings and capital accumulation, as in the standard SOE-RBC models:

$$1 + \frac{\partial \Phi(b_t)}{\partial b_t} = \beta E_t \left[\frac{\lambda_{t+1}}{\lambda_t} R_t \right] \tag{12}$$

$$1 + \frac{\partial \Theta(k_t, k_{t+1})}{\partial k_{t+1}} = \beta E_t \left[\frac{\lambda_{t+1}}{\lambda_t} (1 + r_{t+1} - \delta - \frac{\partial \Theta(k_{t+1}, k_{t+2})}{\partial k_{t+1}}) \right]. \tag{13}$$

These conditions tell us that bond holdings and capital are at their optimal level when the marginal cost of additional bonds (or capital) is equal to their expected discounted value to households.

Before ending this section, we note that the different preference specifications have implications for the behaviour of the marginal utility of consumption. When preferences are separable, the marginal utility of consumption for each family member is given by

$$\lambda_t = c_t^{-\sigma},$$

which implies equal consumption across employed and unemployed household members, since we assume that there is perfect risk sharing within the family. However, in the case of JR preferences, equal marginal utilities do not necessarily imply equal consumption levels across the employed and unemployed, since labour enters the marginal utility of consumption as

$$\lambda_t = (c_t^e - \varphi^e l_t^\eta x_t)^{-\sigma} + \tau_t \gamma \frac{x_t}{c_t} \tag{14}$$

$$\lambda_t = (c_t^u)^{-\sigma}. \tag{15}$$

If we denote the marginal value of the consumption habit by τ_t, then the optimality condition for the consumption stock, x_t, in JR preferences states that

$$(c_t^e - \varphi^e l_t^\eta x_t)^{-\sigma} \varphi^e l_t^\eta + \tau_t = \beta E_t \left[(1-\gamma)\tau_{t+1} \frac{x_{t+1}}{x_t} \right].$$

3.3 Nash Bargaining

After the vacancy is filled, wages and working hours per worker are set through a Nash bargaining game between the firm and the worker in the following manner:

$$(w_t, l_t) = \arg\max_{w,l} \left(\frac{V_n^H}{\lambda_t} \right)^{\mu} \left(V_n^F \right)^{1-\mu},$$

where μ is the bargaining power for the worker. The problem above is subject to the value of an additional worker to the firm and household derived earlier as equations (6) and (11), respectively. Here, V_n^H is divided by λ_t in order to express everything in terms of consumption units.

Taking the derivative with respect to wages, we have the *sharing rule* between the firm and the household, which states that the total matching surplus is shared between parties according to their bargaining power:

$$\frac{V_n^H/\lambda_t}{V_n^F} = \frac{\mu}{1-\mu}. \tag{16}$$

We can also obtain the condition for the optimal level of working hours by taking the derivative of the problem above with respect to hours per worker:

$$-\frac{u_l}{\lambda_t} = \frac{y_{nl}}{(1+\theta(R_{t-1}-1))}, \tag{17}$$

where $u_l \equiv \frac{\partial u}{\partial l}$ and $y_{nl} \equiv \frac{\partial y}{\partial nl}$, with nl denoting the total labour input. This equation implies that at the optimal point the marginal loss of increasing one more labour hour in units of the consumption good has to be equal to the value of additional product that the firm earns. Note that an additional labour hour increases the value of production by less than it would if there were no working capital requirement because of the interest burden on the firms.

3.4 Equilibrium Prices and Allocation

Given the initial conditions and a sequence of exogenous interest rates and productivity, R_t and A_t, a search equilibrium consists of a state-contingent sequence of allocations $\{c_t[c_t^e, c_t^u, x_t], l_t, k_{t+1}, i_t, b_t, n_t, v_t\}$ and of prices $\{w_t, r_t\}$ such that

(i) the allocations solve the firm and household problems at the equilibrium prices,
(ii) the Nash bargaining solutions are satisfied,

(iii) the market for capital clears, i.e, firms' capital demand is equal to the capital supplied from households: $k_t^{demand} = k_t^{supply} = k_t$,
(iv) goods markets clear:

$$c_t + i_t + nx_t + \kappa v_t + \Phi(b_t) = y_t, \tag{18}$$

which implies that the goods that are not spent on consumption, investment, the cost of recruiting activities or of bond holdings represent the net export for the economy, nx_t.

4 Quantitative Analysis

The model is solved by log-linearizing the equilibrium conditions around the steady state,[19] which is then parameterized so that the deterministic steady state of the model matches several average ratios of macroeconomic aggregates of the Mexican economy. We choose Mexico given its longer quarterly data and representative co-movements of hours per worker and employment over the cycle among emerging markets, particularly procyclical hours per worker and employment, and the positive correlation between these margins. The period in the calibration is 1993Q1-2008Q4, for which we have quarterly data from the OECD and Mexican National Statistics (INEGI). A summary of parameter values from the calibration is provided in Table 3.

4.1 Calibration of Parameter Values

Parameter Values. The values of the quarterly depreciation rate, δ, and the investment-output ratio, i/y, determine the value of the capital-output ratio, $\bar{k}/\bar{y}$. The optimality condition for capital demand and the arbitrage condition for bond and capital holdings at the steady state, $\bar{R} = 1 + \bar{r}^k - \delta$, then yield the value of the real interest rate. We set $\delta = 0.025$ and $i/y = 0.19$ using Mexican data. Setting the capital share as $\zeta = 0.36$, together with the remaining parameters, yields a value for the capital-output ratio of $\bar{k}/\bar{y} = 7.6$. This ratio is equal to 1.9 at the annual frequency, and is close to the annual finding for Mexico (2.09) in Nehru and Dhareshwar (1993) using historical series over the period 1950-1990. Given the capital-output ratio, the steady-state interest rate is calculated as 2.24%.

For the parameters of preferences, the coefficient of relative risk aversion, σ, is set equal to 2. We then calibrate the parameters for the elasticity of the labour supply in separable and JR preferences, ν and η, respectively, so that the model matches a Frisch elasticity of the labour supply of 0.5, which is in the range given by Blundell and MaCurdy (1999).[20]

[19] We use the Dynare routine to solve the log-linearized equilibrium conditions. See Adjemian et al. (2011).

[20] Blundell and MaCurdy (1999) estimate the elasticity of the labour supply to be in the range of [0.5,1] for the United States. We used the low end for Mexico since incomes are much lower than in the United States.

This implies parameter values for ν and η equal to 1.77 and 2.66.[21] Hours per worker at the steady state, $\bar{l}$, is set to 0.53, which is the ratio of total hours worked to non-sleeping hours per employee in Mexico. The leisure weight coefficients, φ^e and φ^u, for separable preferences are determined using the optimality condition for hours worked and optimal wage equation at the steady state. Similarly, the coefficient of disutility of labour, φ^e, in JR preferences is determined using the optimality condition for hours worked at the steady state. The parameter that governs the strength of the income effect, γ, in JR preferences affects the consumption ratio across employed and unemployed agents. Since we do not have data on consumption values for the unemployed and employed separately for Mexico, we use evidence from the United States, which suggests that the unemployed have 15% lower consumption than the employed.[22] Therefore, we calibrate γ to 0.75 so that $c^u = 0.85c^e$ at the steady state.

For the matching parameters, the natural breakup rate, ψ, is set equal to 0.06 following the estimates in Bosch and Maloney (2008) for Mexico. The steady-state employment is chosen equal to one minus the unemployment rate (3.6%) in Mexico over the sample period. The steady-state value of matches, $\bar{M}$, follows from $\bar{M} = \psi\bar{n}$. We then calculate the vacancy rate at the steady state, $\bar{v}$, assuming the job-filling rate to be 0.7 following Boz et al. (2009), which implies an average vacancy duration of 45 days. Following Andolfatto (1996), the matching exponent, α, is assumed to be 0.5. Using the steady-state values for matches, employment and vacancies together with the value of α, the matching efficiency parameter, ω, is obtained as 0.66. We assume an equal bargaining power ($\mu = 0.5$) between the firm and the worker due to a lack of empirical evidence for Mexico. The recruiting cost parameter, κ, is then calculated as 0.78 so that the wage equation implies an equal bargaining power. This suggests that recruiting costs, $\kappa\bar{v}$, are around 4% of output.

The working capital parameter, ϕ, is assumed to be 1 as in Neumeyer and Perri (2005), which implies that workers have to be paid three months before the sales are cashed out. The net foreign asset ratio held by households at the steady state, $\frac{\bar{b}}{\bar{y}}$, is calculated using the debt ratios from Lane and Milesi-Ferretti (2007) that are estimated from the external wealth of countries. The ratio of net foreign assets to GDP for Mexico in this data set is equal to -0.40. Note that, in our model, net foreign assets is the household's foreign bond holdings net of the working capital loans of the country: $b_t - \phi w_t l_t$. Accordingly, the ratio $\frac{\bar{b}}{\bar{y}}$ is calculated as 0.17. The ratio of economic profit and output is found to be 0.0028 in the model, which is different from zero due to the frictions in the labour market. Using the

[21] In the case of separable preferences, the Frisch elasticity is equal to $\frac{1-\bar{l}}{\bar{l}}\nu^{-1}$ where $\bar{l}$ is the steady state of hours per worker. We do not have a closed-form equivalent in the case of JR preferences. Therefore, we calibrate η in JR preferences numerically. Specifically, we regress hours per worker on wages and the marginal utility of wealth using simulated model results to match the Frisch elasticity of 0.5, the coefficient of wages in the regression.

[22] See Hall and Milgrom (2008), Shimer (2009) and Hall (2009).

steady-state values of profits, household earnings from output, investment, bond holdings and the interest rate, we calculate the consumption-output ratio at the steady state as 0.76, which is close to the Mexican consumption-output ratio of 0.75.

Finally, the functional form for the quadratic convex cost functions for bond holdings and capital adjustments can be written as $\Phi(b_t) = \frac{\phi^b}{2} y_t (\frac{b_t}{y_t} - \frac{\bar{b}}{\bar{y}})^2$ and $\Theta(k_t, k_{t+1}) = \frac{\phi^k}{2} k_t (\frac{k_{t+1} - k_t}{k_t})^2$ following the literature in small open economies. The cost parameter for bond holdings, ϕ^b, is set to be as small as 0.01, so that it does not change the business cycle volatilities but ensures that the model is stationary. For the parameter, ϕ_k, we follow the estimates in the literature using similar functional forms and set it to 25, which implies an investment volatility nearly three and a half times the output volatility observed in the data for Mexico.

Shock Processes. The recent literature has shown the importance of interest rate shocks for the fluctuations in emerging markets.[23] Emerging markets differ from developed markets in terms of the behaviour of the interest rate they face. Interest rates are countercyclical mainly because of default risk that is negatively correlated with output. Following this literature, we assume that shocks to productivity (in logs) and interest rates (log of the *gross* interest rate) are correlated simultaneously such that $\epsilon_t = [\epsilon_t^A, \epsilon_t^R]$ is drawn from an i.i.d. normal bivariate distribution, $N(0, \Sigma)$, with zero mean and covariance, Σ. Each shock follows an independent AR(1) process:

$$\widehat{A}_t = \rho_A \widehat{A}_{t-1} + \epsilon_{A,t}$$
$$\widehat{R}_t = \rho_R \widehat{R}_{t-1} + \epsilon_{R,t},$$

with

$$\Sigma_{\epsilon_t \epsilon_t'} = \begin{pmatrix} \sigma_{\epsilon_A} & \rho_{\epsilon_A,\epsilon_R}\sigma_{\epsilon_A}\sigma_{\epsilon_R} \\ \rho_{\epsilon_A,\epsilon_R}\sigma_{\epsilon_A}\sigma_{\epsilon_R} & \sigma_{\epsilon_R} \end{pmatrix}.$$

For the parameter values governing TFP shocks, we choose a calibration strategy that aims to match the standard deviation and the serial correlation of GDP following Neumeyer and Perri (2005). An alternative could be to construct Solow residuals and estimate these parameters. However, because of the measurement problems in the factors of production in developing economies (the quality of capital stock and/or capacity utilization, for example), we choose not to use Solow residuals (see Mendoza, 2008).[24]

[23] See Neumeyer and Perri (2005), Arellano (2008), Mendoza (2010) on the role of interest rates in the output fluctuations in emerging markets.

[24] Nevertheless, we constructed Solow residuals using capital stock generated from an investment perpetual method with assumptions on the initial capital-output ratio. These series imply much lower persistence for TFP relative to those counterparts in developed markets, and not consistent with highly persistent output observed in the data. However, using these series in the model does not change our main results on labour market fluctuations. The results from this parameter specification can be obtained upon request.

For the interest rates, we have two different representative costs of borrowing: the Emerging Markets Bond Index Plus (EMBI+) data set from Uribe and Yeu (2006) and real domestic interest rates on Mexican T-bills from the International Financial Statistics. EMBI+ data set documents spreads for traded debt instruments for various countries including Mexico. Kabaca (2011) shows that the interest rates constructed using these spreads have a significantly smaller volatility than that of domestic rates. In fact, the standard deviation of Mexican rates from EMBI is around 0.55% at quarterly levels, whereas the domestic rates are almost four times more volatile, 2.05%.[25] Although EMBI+ rates have been widely used in the literature as the representative cost of borrowing, this discrepancy between two rates raises questions on the other potential costs of external borrowing, which EMBI+ ignores.[26] That is why we take the volatility of EMBI+ rates as the lower bound of the volatility of the cost of borrowing and that of domestic rates as the upper bound. When we assume that shocks to interest rates have the same volatility as the productivity shocks, $\sigma_A = \sigma_R = 1.56\%$, the interest rates in the model represent a volatility around the average of standard deviations of the two interest rate series.

For the persistence of shocks to interest rates, ρ_R, we use the autocorrelation coefficient of 0.68 coming from EMBI-constructed rates.[27] We set the parameter for the correlation between productivity and interest rate shocks, $\rho_{\epsilon_A,\epsilon_R}$, to -0.60 so as to match the correlation between interest rates and output over the cycle (-0.44).

4.2 Characterization of Equilibrium and Impulse Responses

Without Working Capital. We next discuss the role of search and financial frictions and how endogenous decisions at the intensive margin affect the amplification that such frictions generate. We start by discussing the case with only search frictions to show their sole effects on the fluctuations as a response to shocks to productivity and interest rates. The key equation in the models with search frictions is the wage equation. Regardless of the separability in preferences, we can write down the optimal wage equation by combining the share rule in equation (18) with equations (4), (6) and (11) in the absence of a working capital requirement (i.e., $\phi = 0$):

$$w_t l_t = \mu(y_{n,t} + \kappa E_t \Pi_{t,t+1} \theta_{t+1}) + (1-\mu)\frac{u_t^u - u_t^e}{u_{c,t}}, \tag{19}$$

[25] Here, it is crucial to take the quarterly yields on these bonds, since gross interest rates, not net ones, are logged. Therefore, taking the annualized value at the quarterly frequency will mistakenly increase the volatility of interest rates by four times.

[26] These might include the limited and varying access to financial markets, exchange rate risk exposure in the eyes of domestic agents, strategic issuance of bonds and withdrawals from financial markets. For example, Fostel and Geanakoplos (2008) show that an emerging-market asset can have leverage cycles because of asymmetric information problems in the financial markets even when the price of the debt does not change for that particular asset in international markets.

[27] The coefficient from an estimation using domestic rates implies a value closer to the one used here (0.60). We note that it is within the 95% confidence interval for the estimate used in the paper.

where we have substituted for λ_t using the marginal utility of consumption as u_c.

The above condition tells us that labour income of the employed (wage bill per job) is a combination of the worker's contribution to output at the margin (which is the marginal productivity and the average savings in vacancy costs) and the worker's outside option (which is the utility of foregone leisure evaluated in terms of the marginal utility of consumption) depending on the bargaining power of the household. The second term, which makes the wage equation different from that in the standard RBC model, becomes much more important in a model with interest rate shocks. During recessions, a negative productivity shock coupled with a higher interest rate causes a larger drop in consumption than in the case with just productivity shocks.[28] As a result, the wage bill falls not only because marginal productivity decreases but also because the worker's outside option drops due to a higher marginal utility of consumption. In other words, the expected value of staying unemployed and searching for a job in the next period becomes smaller.

However, note that the amplification of this mechanism on wages depends on the changes in the hours per worker, l_t. Movements in the hours per worker will affect the fluctuations in wages not only through its effect on the wage bill but also through its effect on the marginal utility of consumption. To illustrate this point, we explore the optimal decision for the intensive margin. The log-linearized version of equation (19) for each form of utility can be expressed as

$$\widehat{l}_t = \frac{\widehat{A}_t + \zeta\widehat{k}_t - \zeta\widehat{n}_t - \sigma\widehat{c}_t}{\frac{\nu\bar{l}}{1-\bar{l}} + \zeta} \qquad \text{(separable preferences)} \tag{20}$$

$$\widehat{l}_t = \frac{\widehat{A}_t + \zeta\widehat{k}_t - \zeta\widehat{n}_t - \widehat{x}_t}{\eta - 1 + \zeta} \qquad \text{(JR preferences).} \tag{21}$$

The difference in these equations derives from the strength of the income effect they have on the labour supply decisions. This effect is captured by $\sigma\widehat{c}_t$ in separable preferences and is stronger than in JR preferences, where $\widehat{x}_t = \gamma\widehat{c^e}_t + (1-\gamma)\widehat{x}_{t-1}$. The impulse responses in Figure 1 show us that hours per worker increases as a response to a positive shock to interest rates in the model with separable preferences. This also generates an increase in output when the interest rate goes up. This result is inconsistent with the data, where both output and hours per worker tend to be decreasing during the periods with higher interest rates in emerging markets, as discussed in section 2. In addition, hours per worker decreases and stays below the steady state after a positive productivity shock for a long time (around 50 periods), which makes labour input negatively correlated with output.

Note that these counterfactual results make wages more responsive to interest rates. In order for the wage bill to fall, the wage has to decrease sharply as a response to an interest rate shock (see blue and black lines in Figure 1 for comparison). The wage response is

[28]See Neumeyer and Perri (2005) for details on the effect of interest rates on consumption.

still high when we take the intensive margin as fixed. Thus, the wage responds more in these cases at the expense of movements in the intensive margin of labour input. On the other hand, when we take JR preferences, which have a smaller income effect on the intensive margin, responses of hours per worker improve both to productivity and interest rate shocks. This improvement in hours comes at a cost: the wage response becomes smaller to the productivity shock. Therefore, the intensive margin plays an important role in the contribution of search frictions on wage fluctuations.

Separable preferences imply somewhat weak results on other variables as well, such as employment and consumption. The counterfactual responses in hours per worker with separable preferences tend to produce weaker responses in employment to productivity shocks than JR preferences. This is because a decrease in hours per worker as a response to a positive TFP shock generates a lower marginal contribution of additional workers than those with JR preferences. In addition, with separable utility, consumption tends to be substitutable with leisure, making it less responsive to productivity shocks due to the decrease (increase) in hours per worker (leisure) at the same time.

With Working Capital. Although JR preferences reduce the income effect on the labour supply, the hours per worker and output still increase and stay above their steady states after a positive shock to the cost of borrowing. In addition, the employment response is still muted in quantity even with JR preferences. One can further decrease the strength of the income effect but, as we will show in the sensitivity analysis, this will result in a large drop in the response of wages. Instead, here we show that the presence of a financial friction, namely working capital, dominates the income effect on the labour supply and predicts the right movements for hours per worker, amplifying the fluctuations in the labour market as well. In the presence of a working capital requirement, equation (23) can be rewritten as

$$\widehat{l}_t = \frac{\widehat{A}_t + \zeta\widehat{k}_t - \zeta n_t - \widehat{x}_t - \frac{\phi(\bar{R}-1)}{1+\phi(\bar{R}-1)}\widehat{R}_t}{\eta - 1 + \zeta}.$$

Since $\phi > 0$, the above equation implies that a positive shock to interest rates will have a negative effect on hours per worker. This suggests that the demand for labour in the model economy as a response to a positive interest rate shock is lower in the case with working capital than before. In fact, the impulse responses in the presence of working capital (Figure 1, red line) show that hours per worker tends to decrease as a response to an interest rate shock in the second period, and to stay below steady state. This generates an output drop after an increase in the interest rate consistent with the data. Notice that the model with working capital also increases the responsiveness of wages to interest rates significantly. This result can be seen through the wage equation in the model with working capital. The wage bill in the presence of working capital can be expressed as

$$w_t l_t = \frac{1}{1+\mu\phi(R_{t-1}-1)} \left\{ \mu(y_{n,t} + (1+\phi(R_t-1))\kappa E_t \Pi_{t,t+1}\theta_{t+1}) + (1-\mu)\frac{u_t^u - u_t^e}{u_{c,t}} \right\}. \tag{22}$$

Therefore, introducing working capital not only affects the composition of the wage bill between wages and hours per worker, but also makes total labour income more responsive to shocks. As a result, wages become more volatile without sacrificing movements in hours per worker.

For the other impulse responses, it is worth noting the responses of employment as well. Employment shows significantly stronger responses under the baseline scenario with working capital. Similar to the demand for hours explained earlier, firms' vacancy postings depend more on the cost of borrowing due to the working capital requirement in the baseline model. An increase in interest rates makes posting vacancies more costly for firms and therefore leads to a smaller number of matches between jobs and workers. The friction discussed here plays a smaller role for goods market variables (consumption and net exports) than for labour market variables.

4.3 Quantitative Results

We summarize the results from simulations of various versions of the model in Tables 4 and 5. We first simulate the model with only search frictions with a fixed intensive margin as in Boz et al. (2009). We then continue with results from the model with the endogenous intensive margin for both types of preferences. In doing this, our aim is to analyze how much search frictions contribute to fluctuations in emerging markets, discussed in earlier sections, particularly consumption, real wages and labour share that are highly volatile, wages, labour input and labour share that are procyclical, countercyclical net exports, and a positive correlation between employment and hours per worker. Lastly, we simulate the model with working capital to investigate the effect of a financial friction on these fluctuations over and above the effect of search frictions.

Fixed and Endogenous Intensive Margin. The first column in Table 4 shows the business cycle moments in the data for Mexico. The second and third columns report the implications of the search model with a fixed and endogenous intensive margin under separable preferences. When hours per worker is taken as constant, as in Boz et al. (2009), the search model can explain some distinguishable characteristics of the fluctuations in emerging markets, such as procyclical and highly volatile consumption and countercyclical net exports. However, the SOE-RBC alone, with fixed labour input, does a similar job in terms of these fluctuations. The contribution of search frictions to these fluctuations is therefore minimal.

Table 4 shows that the search model has a stronger effect on the response of labour market variables than the standard SOE-RBC (second versus fourth column). Similar to Andolfatto (1996) and Merz (1995), we find a significant contribution of search frictions to the fluctuations in the labour market rather than the goods market. For instance, the second column shows a significant increase in wage volatility compared to the one in SOE-RBC. However, as we have shown above, wages here are the only variable to respond in the wage bill per job, since the intensive margin is fixed. Nevertheless, the search model gives momentum to the labour share, whereas this is constant in the frictionless SOE-RBC model.

Although search frictions seem to amplify the responses of labour market variables, particularly wages and the labour share, the results change considerably when we let the intensive margin respond endogenously under separable utilities. The third column shows that the model implies a large income effect, which consequently causes a weak co-movement with output for hours per worker. As a result, the cyclical properties of the search model fail to match the ones in the data. The intensive margin becomes negatively correlated with the extensive margin, since hours per worker responds differently to the shocks. This makes total hours less cyclical over the cycle. Since hours tend to be weakly correlated with output, the labour share also becomes negatively correlated with output in this model, whereas it is significantly procyclical in the data. In addition, wages become more volatile at the expense of counterfactual movements in the intensive margin. Consumption, too, becomes weakly cyclical, due to the strong income effect, which leads counterfactual movements for net exports. These failures with separable preferences show that it is important to understand the intensive margin decisions in order to assess the contribution of search frictions to the fluctuations in emerging economies.

Baseline Model. The results with JR preferences are reported in Table 5. Our baseline model (the second column), which has JR preferences and working capital, improves the implications of the model significantly. With a reduced income effect due to JR preferences and a more effective labour demand due to working capital, the model can mimic the cyclical properties of the variables that are related to the labour market. As well, the model does a better job on the cyclical properties of consumption and net exports relative to the alternatives.

In the baseline model, the co-movement between hours per worker and employment rates has the right sign. These margins of work are positively correlated with each other, as in the data, since they respond similarly to both shocks in the model. This is in contrast to the implications from the model with separable preferences, discussed earlier. For additional comparisons, we include the results from the frictionless SOE-RBC model (third column of Table 5) and the results from the model with only search frictions; i.e., without working capital (fourth column). Although the model without working capital (labeled as "search only") can partially improve the correlation between the margins of the work relative to the model with separable preferences due to the smaller income effect, it is not enough to explain the co-movement that we observe in the data.[29] However, it implies some results for developed markets. As we lower the short-term financial requirement, similar to that in developed markets, hours per worker becomes less cyclical and the co-movement between the margins of work becomes smaller, a result we reported in Table 1 for developed markets compared to emerging markets.

Another distinctive business cycle characteristic of emerging markets is the high volatility of wages. The baseline model can explain such highly volatile wages thanks to the presence of both search and financial frictions. Without the financial friction, wages become less volatile than in the data. In terms of the co-movement with output, the baseline model implies a smaller correlation between wages and output than the alternatives, closer to the data. However, it still overpredicts the procyclicality of wages with output. Here, we should mention that wages become more procyclical with the current output in the data when the leads of wages are considered. For instance, the correlation between the current output and wages after two quarters is 0.56 compared to the contemporaneous correlation of 0.40. We leave this lagging property of wages for future research and focus on the volatility in wages in this paper, since they present a strikingly higher volatility in emerging markets than in developed markets. In addition, changes in the composition of employment over the cycle might cause lower cyclicality of aggregate wages than RBC models predict, since the proportion of high-skilled workers increases during recessions (see Bills, 1985).

Since the model can explain highly volatile wages and produces the right sign of co-movement of labour market variables with output, the labour share becomes more volatile than in alternatives, and closer to the data. The model can address more than 80% of the variation in the labour share and its procyclicality with output. The part that is not explained in this model is related to employment fluctuations. The model can explain only about a third of the employment fluctuations. Boz et al. (2009) introduce shocks to matching efficiency, ω, which increases the volatility for this variable.[30] Nevertheless, the baseline model significantly increases the volatility of employment relative to the model with only search frictions, due to the effective demand for vacancy postings generated by the working capital requirement.

The baseline model can also address some of the goods market fluctuations in emerging

[29] One might question the contribution of working capital as opposed to just lowering the strength of the income effect further. To address this question, the sensitivity of the parameter that governs the strength of the income effect, γ, is discussed in section 4.4.

[30] In addition, changes in labour force participation over the cycle could amplify the fluctuations for employment. We do not introduce this margin since we concentrate on the contributions of each friction in a SOE-RBC model in this paper.

economies. Consumption is more volatile than output, and strongly procyclical, as in the data. As a result, net exports are countercyclical in the model. Compared to alternatives, the baseline model implies better results in terms of net exports, since consumption moves with output more in the baseline model. Net exports and consumption cyclicality are closer to the data, albeit still not as strong as in the data.[31] Nevertheless, these results for the goods market variables show that the frictions introduced here to explain labour market fluctuations do not sacrifice movements in goods market variables in emerging economies.

Lastly, the differences in the results between the third and fourth columns give us another understanding of the sole contribution of search frictions to fluctuations in emerging markets. As in the case with the fixed intensive margin, the main contribution of search frictions is their impact on variables related to labour markets as opposed to a frictionless model. Search frictions can produce movements in employment and the labour share. In addition, wages become more volatile than in the frictionless model. However, the effects of search frictions on goods market variables such as consumption and net exports are minimal, consistent with results in Andolfatto (1996) and Merz (1995), where the intensive margin of labour input is endogenous, as in this paper.

4.4 Sensitivity Analysis: The Strength of the Income Effect

The results in Table 6 suggest that with a smaller income effect, the models tend to explain the data moments better than results with separable preferences. With JR preferences, the income effect is governed by the parameter, γ, which is set to be equal to 0.75 in the baseline scenario. In this section, we discuss the sensitivity of the results to this parameter.

Table 6 reports the results from the sensitivity analysis. The first two columns show the data moments and the results from the baseline model. The third and fourth columns show the implications of the model with full income effect ($\gamma = 1$) and zero income effect ($\gamma = 0$), respectively. A higher income effect makes the hours less cyclical. As a result, the margins of labour become less correlated with each other. In addition, the model with the higher income effect generates less cyclical consumption and net exports than we observe in the data.

On the other hand, a model with zero income effect (i.e., GHH preferences) makes consumption and net exports more cyclical over the cycle than in the baseline model. However, these improvements in the goods market variables come at the expense of highly cyclical and volatile hours. The co-movement between hours per worker and output becomes closer to one-to-one, whereas it is smaller in the data. In addition, wages become less volatile when we lower the strength of the income effect.

[31] Other financial frictions such as credit restrictions (see Kabaca, 2011) and shocks to import prices (see Mendoza, 2010) generate stronger consumption and investment movements and consequently amplify the movements of net exports in emerging-market business cycles.

5 Conclusion

The implications of small open-economy real business cycle models for explaining emerging-market business cycles have been studied extensively in recent years. Many of these studies have concentrated on the implications of such models for generating the observed responses of key macroeconomic variables. Yet, increasingly, researchers and policy-makers are interested in understanding the cyclical response of labour market variables in emerging economies. It is well known that emerging-market economies have seen increases in their unemployment rates during their balance-of-payment and/or debt crises in the 1980s and 1990s and recessions afterwards, making employment procyclical. In this paper, we have documented that hours per worker is also procyclical and moves positively with the number of employed. In contrast, hours per worker is less cyclical and moves less with employment in advanced economies.

In our framework, the financial friction that results from a working capital requirement can lead to similar changes to both employment and hours of work in a search-theoretic model. Our framework can also explain highly volatile wages and labour share. Without the financial friction, the search model cannot account for these fluctuations in the presence of an endogenous intensive margin of work.

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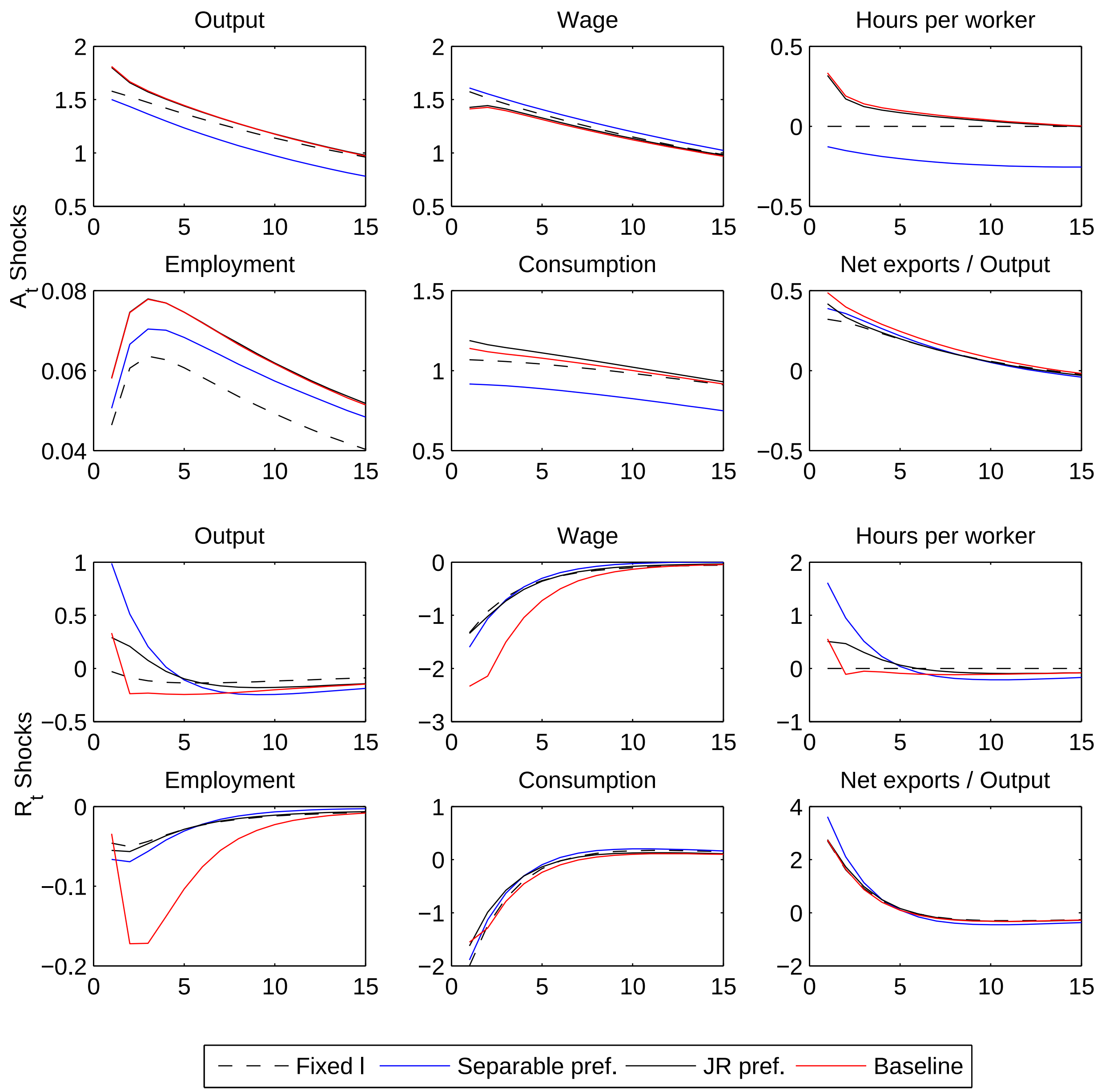
Figure 1: Impulse responses



Note: The y-axis measures the percentage points deviation from steady state and the x-axis measures quarters from the shock. The dashed line represents the model without the endogenous intensive margin and working capital. Blue and black lines include the endogenous intensive margin using separable and JR preferences, respectively. Baseline (red line) introduces the working capital requirement.

Table 1: Movements in employment and hours per worker

	$\frac{\sigma(e)}{\sigma(y)}$	$\frac{\sigma(h)}{\sigma(y)}$	$\rho(e,y)$	$\rho(h,y)$	$\rho(e,h)$		$\frac{\sigma(e)}{\sigma(y)}$	$\frac{\sigma(h)}{\sigma(y)}$	$\rho(e,y)$	$\rho(h,y)$	$\rho(e,h)$
EMs						DMs					
Argentina	0.58	0.48	0.82	0.58	0.89	Austria	0.60	0.96	0.70	-0.43	-0.62
Brazil	0.70	1.11	0.26	0.56	0.34	Canada	0.72	0.41	0.88	0.42	0.34
Colombia	0.54	0.21	0.45	0.20	0.58	Denmark	0.76	0.81	0.58	0.24	-0.01
Hungary	0.81	0.72	0.28	0.02	0.10	Finland	0.86	0.42	0.84	0.54	0.10
Korea	0.67	0.50	0.93	0.75	0.58	France	0.81	1.15	0.77	-0.12	-0.63
Mexico	0.45	0.17	0.78	0.73	0.68	Germany	0.75	0.95	0.76	0.16	-0.13
Turkey	0.39	1.37	0.46	0.62	0.08	Italy	0.99	0.58	0.45	0.48	0.15
Average	**0.59**	**0.65**	**0.57**	**0.49**	**0.46**	Norway	1.00	0.63	0.44	0.26	-0.26
						Spain	1.34	0.74	0.97	0.24	0.03
						Sweden	1.01	1.01	0.28	0.44	-0.23
						U.S.	0.92	0.63	0.84	0.61	0.32
						Average	**0.89**	**0.75**	**0.68**	**0.26**	**-0.09**

Note: EMs and DMs stand for emerging markets and developed markets, respectively. The data cover the period 1981 to 2008, and are HP-filtered using the annual smoothing parameter, 6.25. The variables are GDP (y), employment (e), and hours per worker (h). See the appendix for data sources.

Table 2: Correlation between spread and labour in emerging markets

	ARG	BRA	COL	HUN	KOR	MEX	TUR	**Average**
$\rho(s,e)$	-0.60	0.36	-0.27	-0.23	-0.84	-0.76	-0.54	-0.41
$\rho(s,h)$	-0.48	-0.15	-0.28	0.23	-0.77	-0.69	-0.67	-0.40
$\rho(s,y)$	-0.75	-0.21	-0.31	-0.38	-0.96	-0.62	-0.93	-0.59

Note: The data are HP-filtered using the annual smoothing parameter, 6.25. The variables are GDP (y), employment (e), and hours per worker (h). See the appendix for data sources.

Table 3: Parameter values

Parameter	Value	Source	Parameter	Value	Source
I. Preferences			*III. Production*		
Discount factor, β	0.98	calibrated	Capital exponent, ζ	0.36	literature
Relative risk aversion, σ	2	literature	Working capital, ϕ	1	set
Separable Pref.					
Labour curvature, ν	1.77	calibrated	*IV. Shocks*		
Coef. of leisure (emp.), φ^e	0.36	calibrated	Persistence, ρ_A	0.95	literature
Coef. of leisure (unemp.), φ^u	-0.69	calibrated	Persistence, ρ_R	0.68	estimated
JR Pref.			Correlation coef., $\rho_{\epsilon_A,\epsilon_R}$	-0.65	calibrated
Labour curvature, η	2.24	calibrated	Std. deviation, σ_{ϵ_A}	0.0156	calibrated
Coef. of disutility (labour), φ^e	1.14	calibrated	Std. deviation, σ_{ϵ_R}	0.0156	calibrated
Income effect, γ	0.75	calibrated			
II. Search			*V. Other*		
Elas. of job matches, α	0.5	literature	Bond holding cost, φ^b	0.01	literature
Matching efficiency, ω	0.65	calibrated	Capital adj. cost, φ^k	25	literature
Cost of posting vacancy, κ	0.78	calibrated	Depreciation rate, δ	0.025	literature
Job separation rate, ψ	0.06	BM (2008)	SS bond holdings, $\frac{\bar{b}}{\bar{y}}$	-0.40	data
Bargaining power, μ	0.50	set			

Table 4: Results with separable preferences

	Data	Search Fixed l	Search Endo. l	RBC Fixed l
CORRELATION				
Corr(n, l)	0.48	-	-0.74	-
CORRELATION WITH Y				
Wage	0.40	0.91	0.47	1.00
Hours per worker	0.58	-	0.11	-
Employment	0.57	0.91	0.52	-
Total hours	0.68	0.91	0.16	-
Labour Share	0.47	0.49	-0.07	-
Consumption	0.92	0.75	0.22	0.73
Net Exports	-0.81	-0.25	0.31	-0.25
STANDARD DEVIATION (RELATIVE)				
Wage	1.79	1.43	1.73	1.00
Hours per worker	0.24	-	0.99	-
Employment	0.43	0.06	0.08	-
Total hours	0.61	0.06	0.93	-
Consumption	1.16	1.44	1.47	1.46
STANDARD DEVIATION				
Labour Share	3.56	1.53	1.19	0.0

Note: This table shows the results of endogenizing the intensive margin of work under separable preferences with only search frictions. For data sources, see the appendix.

Table 5: Results with JR preferences

	Data	Baseline Model	RBC	Search Only $\theta = 0$
CORRELATION				
Corr(n, l)	0.48	0.45	-	-0.42
CORRELATION WITH Y				
Hours per worker	0.58	0.54	0.20	0.12
Employment	0.57	0.76	-	0.84
Total hours	0.68	0.71	0.20	0.36
Wage	0.40	0.75	0.96	0.81
Labour Share	0.47	0.47	0.0	0.34
Consumption	0.92	0.75	0.68	0.70
Net Exports	-0.81	-0.12	-0.07	-0.10
STANDARD DEVIATION (RELATIVE)				
Hours per worker	0.24	0.23	0.29	0.28
Employment	0.43	0.13	0.0	0.07
Total hours	0.61	0.31	0.29	0.26
Wage	1.79	1.79	0.98	1.38
Consumption	1.16	1.22	1.31	1.29
STANDARD DEVIATION				
Labour Share	3.56	2.95	0.0	1.35

Note: JR preferences are used in all models here. The baseline model has both search frictions and working capital with the calibrated parameters described in the text. "Search Only" stands for the baseline model without working capital ($\theta = 0$).

Table 6: Sensitivity analysis

	Data	Baseline Model	Full Income Effect $\gamma = 1$	Zero Income Effect $\gamma = 0$
Correlation				
Corr(n, l)	0.48	0.45	0.40	0.95
Correlation with Y				
Hours per worker	0.58	0.54	0.42	0.95
Employment	0.57	0.76	0.78	0.86
Total hours	0.68	0.71	0.60	0.94
Wage	0.40	0.75	0.73	0.79
Labour Share	0.47	0.47	0.44	0.57
Consumption	0.92	0.75	0.70	0.92
Net Exports	-0.81	-0.12	-0.06	-0.20
Standard Deviation (Relative)				
Hours per worker	0.24	0.23	0.31	0.55
Employment	0.43	0.13	0.13	0.10
Total hours	0.61	0.31	0.38	0.64
Wage	1.79	1.79	1.81	1.17
Consumption	1.16	1.22	1.26	1.03
Standard Deviation				
Labour Share	3.56	2.95	2.94	3.08

Note: JR preferences are used in all models here. The baseline model has both search frictions and working capital with the calibrated parameters described in the text. The third and fourth columns show the results from different values for the parameter, γ, that governs the strength of the income effect.

A Data Description and Sources

Since data from most of the emerging markets start after the 1980s, we take observations after 1981 for developed markets, as well. Hours represent total hours worked in manufacturing from industrial surveys conducted by national sources in emerging economies. We divide total hours by total employment in manufacturing to find hours per worker for these economies. We do the same for developed economies using total hours worked and employment in manufacturing from OECD or national sources. For both groups, hours are consistent with National Accounts in the sense that they both represent hours worked rather than normal or paid hours.

Total employment is the civilian employment. For Turkey, employment data represent the number of employees in the overall economy. The national source releases employment data including unpaid family workers. However, the strong cultural practices might hinder the real labour market outcomes as a response to output variations. This is why we exclude family workers. In the other countries, this is not an issue because this type of employment constitutes a very small part of employment.

Table A1: Data Sources

	Period	GDP	Employment	Hours	Employment (Manufacturing)
Emerging Markets					
Argentina	1995-2008	INDEC	INDEC	INDEC	INDEC
Brazil	1994-2008	WDI	WDI	IPEA	IPEA
Colombia	1990-2008	WDI	DANE	DANE	DANE
Czech Rep.	1991-2008	OECD	OECD	OECD	OECD
Hungary	1995-2008	OECD	OECD	OECD	OECD
Korea	1981-2008	OECD	OECD	OECD	OECD
Mexico	1993-2008	OECD	OECD	INEGI	INEGI
Turkey	1988-2008	OECD	TURKSTAT	TURKSTAT	TURKSTAT
Developed Markets					
Austria	1995-2008	OECD	OECD	OECD	OECD
Canada	1981-2008	OECD	OECD	OECD	OECD
Denmark	1981-2008	OECD	OECD	OECD	OECD
Finland	1981-2008	OECD	OECD	OECD	OECD
France	1990-2005	OECD	OECD	OECD	OECD
Germany	1991-2008	OECD	OECD	OECD	OECD
Italy	1981-2008	OECD	OECD	OECD	OECD
Norway	1981-2008	OECD	OECD	OECD	OECD
Spain	1981-2008	OECD	OECD	OECD	OECD
Sweden	1993-2008	OECD	OECD	OECD	OECD
United States	1987-2008	OECD	BLS	BLS	BLS