

Cyclical Wage Movements in Emerging Markets Compared to Developed Economies: the Role of Interest Rates

Nan Li*
Ohio State University

November 2007

Abstract

This paper documents that, at the aggregate level, (i) real wages are positively correlated with output and, on average, lag output by about one quarter in emerging markets, while there are no systematic patterns in developed economies, (ii) real wage volatility (relative to output volatility) is about twice as high in emerging markets compared with developed economies, and (iii) real wage volatility, as a ratio of output volatility, decreases with the level of financial development across countries. I then present a model of contractual arrangements between workers and employers in a small open economy that helps explain this contrast. Only employers have access to financial and capital markets in the model, but they need to borrow working capital to pay for labor costs before production is carried out. The idea is that countercyclical interest rates and less developed financial markets in emerging markets make it less optimal for employers to provide workers with relatively stable wages, leading to more volatile and procyclical wages. More specifically, the total wage bill is procyclical when the financial cost of hiring labor is countercyclical. The intertemporal substitution effect of countercyclical interest rates on labor input offsets the direct effect of productivity movements, resulting in less responsive employment. Therefore, the wage is exposed to more volatility and displays more procyclicality. This is further demonstrated by calibrating the model using data from Mexico and Canada.

Key words: *cyclical wage, interest rate, labor contract, emerging markets*

JEL classification: *F41, F43, E24, E44*

*I am grateful to Nir Jaimovich, Robert Hall, Peter Henry, Pete Klenow, Benjamine Malin, Ronald McKinnon and John Taylor for many stimulating discussions and insightful comments. I also thank seminar participants at Bank of Canada, Columbia, Johns Hopkins, London Business School, Ohio State University, Stanford, St. Louis Fed and UC Santa Cruz for comments on previous drafts of the paper. The financial support of the Larry Yung Fellowship at the Stanford Freeman Spogli Institute for International Studies is gratefully acknowledged. Correspondence: nanli@mail.econ.ohio-state.edu or Department of Economics, 403 Arps Hall, 1945 N. High Street, Columbus, OH 43210.

1 Introduction

Real wage rigidity has been one of the essential characteristics of many modern macroeconomic models, especially those used for macroeconomic policy evaluations. The class of sticky wage models, originally tailored to mature industrial countries, has been adopted to study a variety of optimal policy rules in the developing world. In contrast to developed economies, emerging economies have lower but faster growing per capita income, higher aggregate uncertainty, and less developed financial sectors. Given these economic differences and the importance of wage stickiness in monetary policy evaluation, a natural question to ask is whether emerging markets share the same characteristics of rigid wages with developed economies.

This paper is motivated by the above observations and has two objectives. The first objective is to document the cyclical behavior of real wages in a sample of emerging economies and contrast it with the wage behavior in developed ones using aggregate data. The second goal is to present a model with contractual arrangements between employers and workers that can reconcile this differential wage behavior in emerging markets versus developed economies. The model highlights the role of countercyclical interest rates (e.g. negative and significant contemporaneous correlation between interest rates and output) and less developed financial markets in emerging markets for explaining the different wage movements. In emerging markets, because of the increasing default risk, interest rates rise when output falls. The increase in interest rates reduces equilibrium consumption through the intertemporal substitution effect and also raises the financial cost of hiring labor, making it more costly for employers to smooth workers' income or consumption. This income effect also leads to less responsive employment, leaving wage compensation ($w \cdot l$) volatile and positively correlated with output. In contrast, in developed countries, interest rates rise during economic expansion, offsetting the cycle and making consumption smoothing easier for employers. Therefore, wages display more stability.

Using a sample of 15 emerging markets and 15 developed economies for the sample period of 1985Q1 to 2005Q4, I document facts suggesting that, at the aggregate level, rigid wages seem to be more or less confined to high income economies. While more stable than output in developed economies, real wages are much more volatile than output in emerging markets. The average real wage volatility (as a ratio of output volatility) in emerging economies is about twice as high as the average relative wage volatility in developed economies. In addition, in emerging markets, real wages are positively correlated with output fluctuations with an average lag of one quarter. The average contemporaneous correlation between the real wage and output is around 0.4. In contrast, real wages display no systematic cyclical pattern with business cycles in developed countries. Furthermore, real wages appear to be more stable in countries with higher levels of financial market development, even after controlling for output volatility.

One striking feature of emerging-market economies is that they experience frequent and dramatic swings in the real interest rates that they face in international financial markets. It has also been documented that there is a negative correlation between real interest rates and aggregate economic activities in emerging market economies (e.g. Agenor and Prasad [2000], Kaminsky et al

[2004], Neumeyer and Perri [2005], and Uribe and Yue [2005]). During economic expansions, interest rates appear to be low, while periods of economic stresses are often accompanied by high interest rates¹. In contrast, real interest rates are acyclical or procyclical in developed economies, most likely reflecting the endogenous monetary policy decisions of central bankers. These observations, together with the aforementioned relationship between financial development and wage stability, serve as this paper’s motivation for linking real wage fluctuations with the cyclical behavior of real interest rates.

Following Mendoza [1991], the leading approach to modelling cyclical economic activities in emerging markets has been the construction of real business cycle models of small open-economy (RBC-SOE). In these models, interest rates are mainly determined exogenously by international financial markets. To construct a model that is consistent with the observed cyclical properties of interest rates, Neumeyer and Perri [2005] introduce a working capital requirement, in a fashion similar to Christiano and Eichenbaum [1995]², to the basic RBC-SOE model. Due to the lack of synchronization between receipts and payments (e.g. “pay-as-you-go” wage schedules, providing trade credit to customers), firms have to finance production input (i.e. labor) before sales are cashed out. In this framework, interest expenses directly add to labor costs. Hence, the countercyclical interest rate shocks in emerging markets, acting as a labor demand shock, amplify productivity shocks and in principle, might help to explain why wages are more volatile than output. However, the standard RBC-SOE models with simple spot labor market predict excessively strong cyclicity between the wage and output, which contradicts observations in both emerging and developed economies (i.e. $\rho(w, y) > 0.9$)³. This is because the wage fluctuations perfectly reflect the variations in the marginal product of labor.

In order to account for the observed cyclical behavior of wage movements, I introduce one modification to the labor market structure in the Neumeyer and Perri [2005] framework. I replace the Walrasian market-clearing mechanism in the labor market with a risk-sharing employment relationship between employers and workers. Before the state is realized, employers and workers negotiate a contract that specifies a set of state-contingent wage compensations and working hours to maximize the weighted average utility of employers and workers for the next period. The contract is renewed every period. Employers are residual income recipients and have access to capital markets and international financial markets. They act like standard infinitely-lived intertemporal utility maximizing agents. In contrast, workers are more risk averse, but cannot access asset

¹Neumeyer and Perri [2005] and Uribe and Yue [2005] document that the real interest rates on external bonds show a negative correlation with the cycle in emerging markets. Kaminsky et al [2004] and Compton and da Costa e Silva [2006] show that domestic short-term treasury rates deflated by consumer price inflation in those countries are also countercyclical.

²The importance of working capital in developing countries is emphasized in Domingo Cavallo [1977]. More recently, Christiano, Gust and Roldos [2004] and Mendoza [2006] also introduce an advanced payment constraint on working capital as well as collateral constraints. Furthermore, Chari, Kehoe and McGrattan [2006] point out that introducing factors (e.g. working capital) other than borrowing constraints helps to predict sudden stops in emerging markets.

³In an earlier version of this paper, I present and calibrate a RBC-SOE model with spot labor market, augmented with working capital requirement. It is available upon request.

markets to intertemporally smooth consumption as employers do. Therefore, an optimal wage-hours contract would incorporate an insurance component so that the wage is decoupled from the underlying labor productivity. In a closed economy without interest rate shocks, contracts would specify a relatively stable wage schedule and more responsive labor inputs because the substitution effect dominates the income effect, as indicated by the implicit contract literature. In an open economy with a countercyclical interest rate, putting aside the wealth effect, the increase in the interest rate during an economic downturn has two effects. First and most directly, it increases the financial cost of hiring labor. Second, through the intertemporal substitution effect, it depresses the consumption of both workers and employers, but more for the workers. This enlarges the income effect on labor supply. Consequently, workers do not cut back their labor supply by much in order to meet their consumption needs. Given a less responsive labor input, the wage becomes more responsive to the shocks, displaying high volatility and large positive correlation with output. In contrast, in developed economies, procyclical interest rates offset the productivity shock and help with consumption smoothing. This makes labor supply more sensitive and more procyclical than the wage. Therefore, wages display more stability.

The labor contract model laid out in this paper is then used to quantitatively assess the role of interest rates and financial markets in accounting for the differential wage behavior in emerging markets versus developed economies. There are two shocks in the economy: a productivity shock and an interest rate shock. I use data from a representative emerging market, Mexico, and a benchmark small open developed economy, Canada, to estimate the parameters of the VAR(1) stochastic process of these two shocks. As in the literature, the international interest rate for Mexico is constructed by subtracting expected U.S. inflation from nominal U.S. dollar denominated interest rates (recovered by EMBI+ spread index). The real interest rate used for Canada is the 90-day corporate commercial paper rate minus the expected inflation rate. The key results are: (i) the labor contract model generates procyclical and more volatile wages for the representative emerging market and countercyclical and more stable wages for the representative developed economy, which are consistent with empirical regularities; (ii) controlling for all the other parameters, the more countercyclical the interest rate, the more volatile and more procyclical the wage; (iii) controlling for the impact of interest rate fluctuation, when the intertemporal debt adjustment cost increases, wages become more volatile relative to output and more positively correlated with output. This implies that a less developed financial market makes it harder for employers to provide relatively stable wages.

The labor market structure assumed in this paper is close to the labor contract model developed by Boldrin and Horvath [1995], which builds upon an earlier literature of implicit labor contract theory (see Baily [1974] and Azariadis [1975], and a survey by Rosen [1985])⁴. The literature on employment contracts highlights the importance of a non-Walrasian labor market in understanding wage-employment behavior. In Boldrin and Horvath [1995], employers have all the bargaining

⁴Other important contributions include Danthine and Donaldson [1992], Beaudry and Dinardo [1995], and Gomme and Green [1995].

power, and ex ante, workers receive the same expected utility from the contract as from selling their labor services in a spot labor market. Thus, the reservation utility of workers fluctuates with the business cycle, creating time-varying bargaining power. In my model, workers and employers commit to stick together. Quitting and firing are not allowed. This leads to a fixed bargaining power that is also consistent with the search and matching literature of wage determination (see Rogerson et al [2005] and Hall [2005]). This simplified assumption limits the concentration of the model to the role of financial factors on wage determination, instead of the labor market condition.

This paper stresses the role of interest rates and financial market development in the wage adjustment process. It is studied in a labor contract framework, which is helpful to understand the risk allocation between workers and employers. However, the institutional and social arrangements especially designed to improve the income distribution over Walrasian labor market outcomes are different between emerging markets and developed countries. Potentially, these mechanisms (e.g. trade union, unemployment insurance, minimum wage requirement, labor mobility, etc.) can serve as alternative explanations of the differential wage movements between these two country groups. These mechanisms are not discussed in this paper, but would be interesting for future research.

The remainder of the paper is organized as follows. Section 2 discusses the data and empirical observations of the cyclical behavior of wages, interest rates, the relationship between wages and financial development for both emerging markets and developed countries. Section 3 presents an RBC-SOE model with a contract labor market. In Sections 4 and 5, I parameterize the models, estimate shock processes for a representative emerging market and a representative developed economy, and simulate the model to investigate the cyclical properties. Section 6 concludes.

2 Wages, interest rates and financial development

This section presents some features of wage and interest rate movements and their relation with the business cycles in 15 small open emerging economies covering various geographic areas – Argentina, Brazil, Chile, Czech Republic, Ecuador, Hong Kong, Israel, Korea, Mexico, Philippines, Russia, Singapore, Slovak Republic, Taiwan and Turkey. To compare the characteristics of emerging economies with developed countries, I also document the same facts for 15 developed countries: the G7 countries, Australia, Austria, Belgium, Denmark, Netherlands, New Zealand, Norway and Sweden. Countries are categorized using the classification system of the Economist Intelligence Unit (EIU). Therefore, only pre-1994 OECD countries are considered as developed economies⁵. The choice of countries and time periods used is governed by the data availability. The sample period covered is from 1985 to 2005. However, for some emerging countries, wage and output data are only available and may be more reliable beginning in the early 1990s. Therefore, data for

⁵There are different categories of developed economies vs. emerging economies provided by different organizations. For example, IFS counts Hong Kong, Singapore, Korea and Taiwan as “developing countries”, but World Economic Outlook categorizes them as “advanced economies” and JP Morgan and the United Nations consider them as “emerging economies”. In this paper, only pre-1994 OECD countries are considered as developed economies, but I also show that wage behavior in Hong Kong, Taiwan and Singapore is similar to that in the other advanced economies.

emerging economies are included as and when they are available. All series are in log (except for real interest rate), deseasonalized, if necessary, and filtered using Hodrick-Prescott (HP) filter.

2.1 Data description

The data contains four major groups of variables: real gross domestic product (GDP) as business cycle indicators, real wage indicators, real interest rate indicators and financial development indicators. Most difficulties come from constructing the second group. Real wage indicator is defined as nominal wage deflated by consumer price index (CPI)⁶. For most countries, there are two types of nominal wage indicators in the data: hourly earning/wage for all economic activities and hourly earning/wage for manufacturing sector⁷ ⁸. For a few countries, there is no direct hourly wage data from any source or no hours of work data to construct the hourly wage. In these cases, nominal wages refer to monthly earnings or daily earnings. The quarterly nominal wage data for developed economies is obtained from the Organization for Economic Co-operation and Development Main Economic Indicators (OECD), while the wage data for emerging markets also comes from the International Financial Statistics (IFS), the International Labor Organization (ILO) and the Economist Intelligence Unit (EIU), due to the limited data availability of any single source (see Data Appendix for detailed data sources for each country in the sample). Since the quarterly data for developing countries is sometimes considered to be of lower quality than annual estimates, I also report the results generated by annual manufacturing wage data (1975-2004). The annual data is collected from IFS, the U.S. Bureau of Labor Statistics (BLS), United Nation's Industrial Statistics Database (UNIDO).

The real interest rates used are the expected 3-month real interest rates at which firms can borrow, and are constructed in the same way as in Neumeyer and Perri [2005]. For developed economies, the expected inflation from the GDP deflator (the average of current inflation and inflation in the previous three periods) is subtracted from the 3-month nominal interest rates to obtain real interest rates. However, as pointed out by Neumeyer and Perri [2005], the real interest rates derived using local expected inflation in emerging markets are not comparable to those in developed economies, due to the high inflation volatility. Therefore, for most emerging countries, real interest rates are computed by taking the sum of EMBI+ spread index or EMBI Global index⁹ and the world real interest rate (the U.S. real interest rate on 3-month Treasury bonds). Of

⁶Real wages are also calculated using GDP deflators, but the results are not reported here since the key results are not very different.

⁷Hourly earnings often include overtime pay, incentive pay, bonuses, etc. Therefore, it is a bit broader than that of hourly wage. The difference is ignored here, as they are very close at quarterly frequency.

⁸I use direct aggregate wage data instead of labor share as measures of wage. As shown in Golin [2002], the labor share data backed out from the National Account can be seriously flawed. For example, self-employment income is often treated as capital income.

⁹The Emerging Markets Bond Index is a benchmark bond market index introduced by J.P.Morgan. EMBI+ tracks total returns for traded external debt instruments in the emerging markets. The index covers Eurobonds and U.S. dollar local market instruments as well as Brady Bonds. EMBI Global is an expanded version of the EMBI+ index. It covers more of the eligible instruments than the EMBI+ by relaxing somewhat the strict EMBI+ limits on secondary market trading liquidity.

the fifteen emerging economies in the sample, eight are included in either the JP Morgan EMBI+ database or EMBI Global database: Argentina, Brazil, Ecuador, Mexico, Korea, Philippines, Russia and Turkey. As for the rest, such U.S. dollar denominated interest rates are not available, and I use the local currency denominated nominal interest rate (3-month Treasury bill rate) reported by local sources and domestic expected inflation in the same fashion as constructing real interest rate for developed countries¹⁰.

The financial market development indicators include the private credit to GDP ratio, capital market openness, country credit and risk rating. Following Levine, Loayza and Beck [2000], I first measure the financial development level by the aggregate private credit provided by banks and other financial institutions as a fraction of GDP, and is obtained from the *Financial Structure Dataset* [2006] (by Beck and Al-Hussainy). The capital market openness attribute is an index constructed by Chinn and Ito [2006]. It is based on the restrictions on cross-border financial transactions reported in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*. The international country risk guide composite index (ICRGC) and the institutional investor country credit rating (IICCR), are reported by the *International Country Risk Guide* and are composite indicators of country political, economic and financial risk. The lower the index level, the higher the risk.

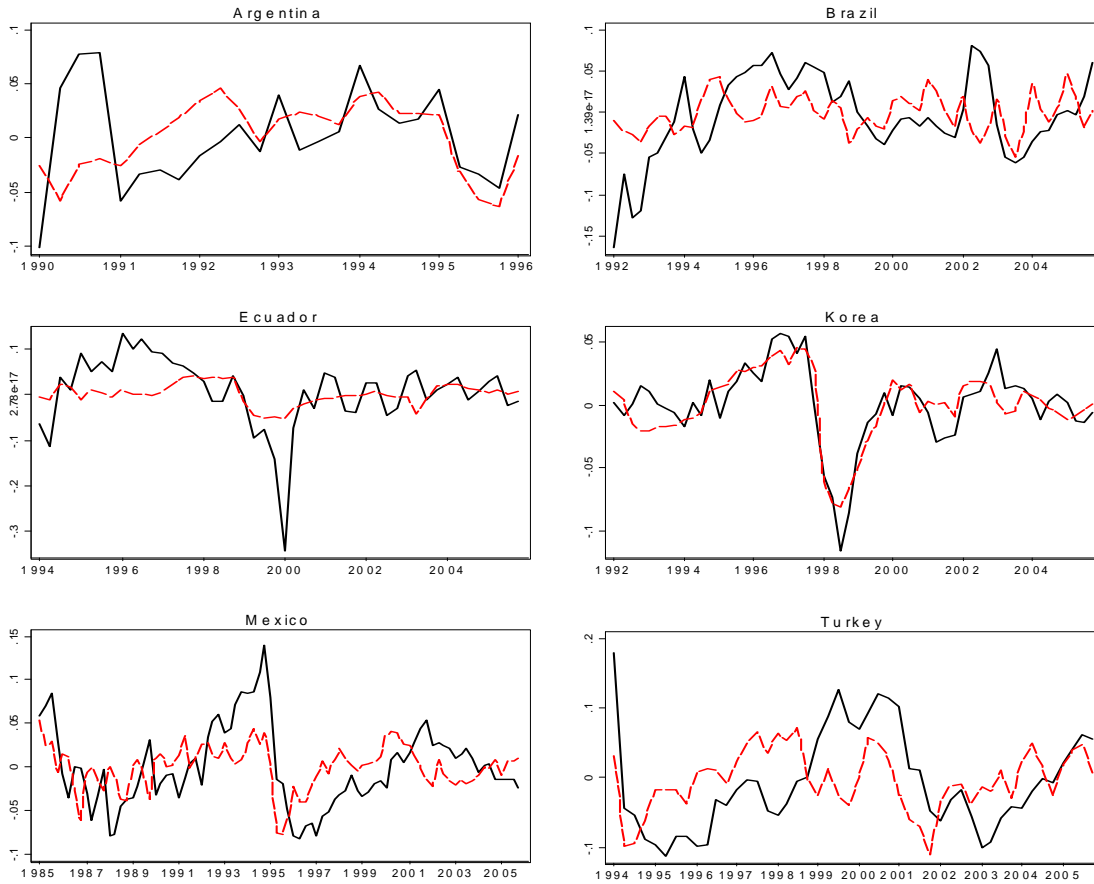
2.2 Observations

The empirical regularities are documented in Figure 1 through 8 and in Table 1 through 3. To give some preliminary examples, Figure 1 and Figure 2 depict the time series of HP-filtered real GDP together with the HP-filtered cyclical component of real wages for six emerging countries (those with EMBI constructed real interest rates) and six small open developed economies. Figure 3 and Figure 4 show the time series of detrended real GDP and real interest rates for the same group of countries. These graphs show that real wages appear to move positively with output in emerging-market economies, but there is no consistent cyclical pattern for real wages in developed countries.

The graphical evidence is confirmed by statistics on cyclical real wage movements across countries presented in Table 1. At business cycle frequencies, the real wage volatility is about 30%–70% more volatile than output in emerging markets, while 30% less volatile than output in developed economies on average. Among emerging economies, Hong Kong, Singapore, Taiwan and Chile also have relatively stable wages. In fact, the three Asian countries are often identified as newly industrialized countries by many organizations, e.g. Standard and Poors [2000] and the International Finance Corporation. Wages in Chile are less volatile than output because in early 80's

¹⁰It is worth noting that in emerging economies, most firms, especially medium or small size firms, borrow in local currencies. Due to currency risk, their debt may be subject to interest rates that are different from interest rates on external bonds. But in the data, these two series of interest rates are positively and significantly correlated.

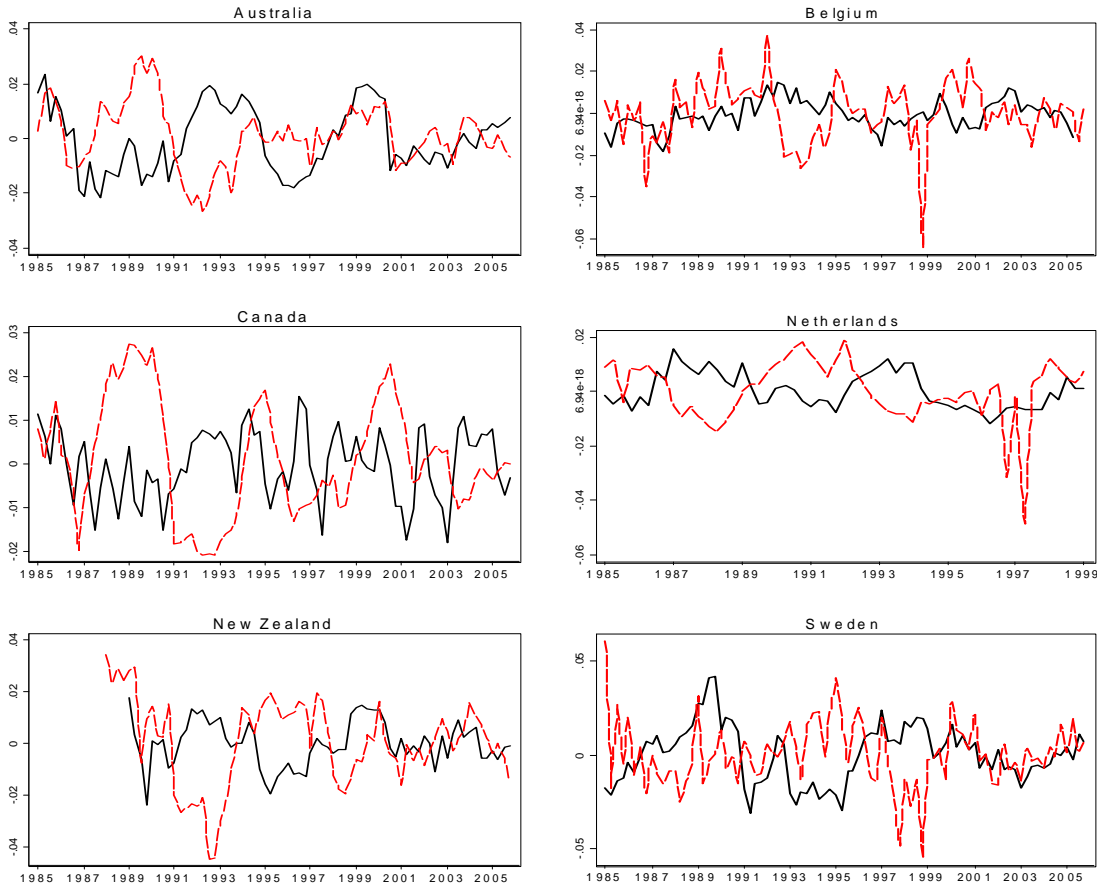
Figure 1: Output and Wages in Emerging Markets



— wage - - - - output

Note: Time series in the figures are percentage deviations from Hodrick-Prescott filtered trend. Output and real wage are seasonally adjusted if a significant seasonal component is identified. The series are logged and filtered using Hodrick-Prescott filter with a smoothing parameter of 1600. Data Sources: IFS, OECD, EIU.

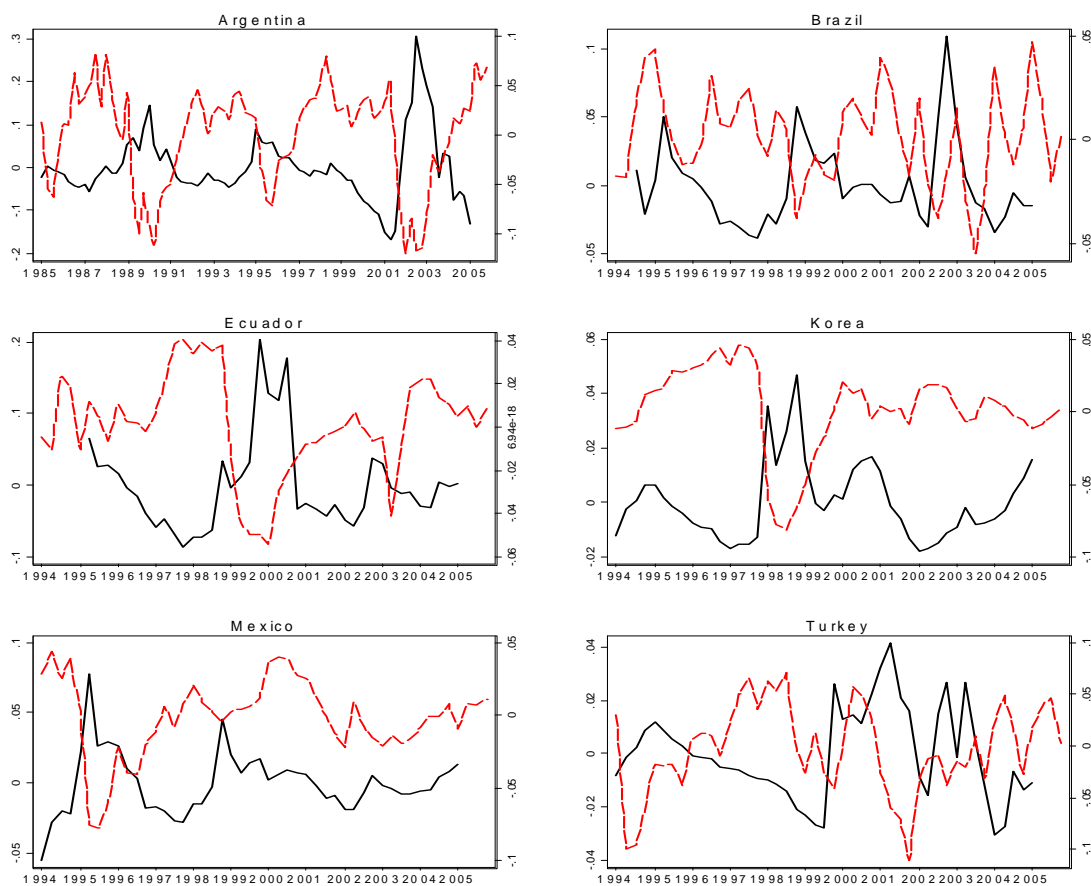
Figure 2: Output and Wages in Developed Economies



— wage - - - output

Note: Time series in the figures are percentage deviations from Hodrick-Prescott filtered trend. Output and real wage are seasonally adjusted if a significant seasonal component is identified. The series are logged and filtered using Hodrick-Prescott filter with a smoothing parameter of 1600. Data Sources: IFS, OECD.

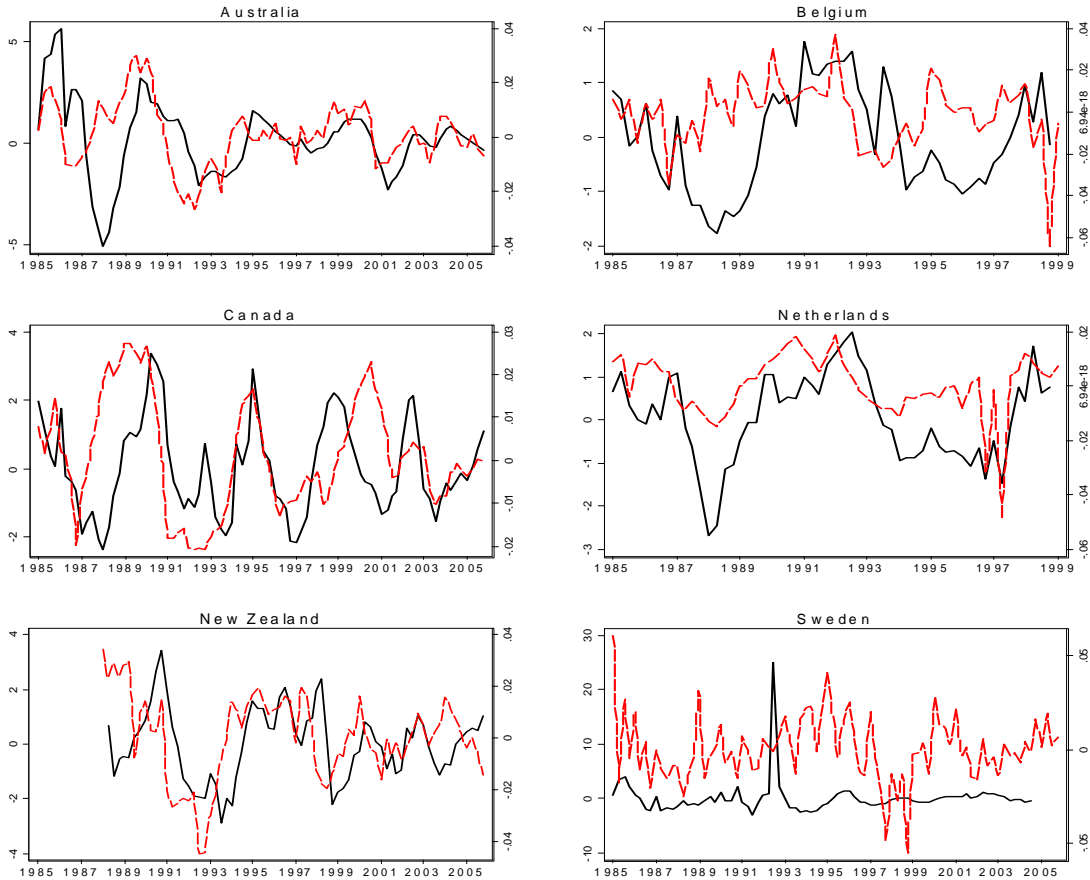
Figure 3: Output and Interest Rates in Emerging Economies



— interest rate - - - - output

Note: Time series in the figures are percentage deviations from Hodrick-Prescott filtered trend. Output data (left-hand-side y-axes) is seasonally adjusted and in log. Country interest rates (right-hand-side y-axes) are real yields on dollar-denominated bonds of emerging countries issued in international financial markets. Data Sources: output, IFS; interest rate, EMBI+, (Argentina, Neumeyer and Perri (2005)).

Figure 4: Output and Interest Rates in Developed Economies



— interest rate - - - - output

Note: Time series in the figures are percentage deviations from Hodrick-Prescott filtered trend. Output data (left-hand-side y-axes) is seasonally adjusted and in log. Country real interest rates are obtained by subtracting the expected GDP deflator inflation from the nominal short-term interest rate. Expected inflation is computed as the average of inflation in the previous three periods and the current period. Data source: IFS, OECD

the Chilean government mandated that wages should be adjusted at least one-for-one with past inflation, thereby reducing the flexibility of wage adjustment. On average, real wage volatility (as a ratio of output volatility) in emerging economies, measured either by the manufacturing wage or by the average wage for all economic activities, is about twice to three times as volatile as that in the developed ones. These results still hold when comparing the weighted average (weighted by country size - average real GDP over the sample period) of relative wage volatility between these two sets of economies.

Furthermore, using the unconditional correlation coefficient between the detrended real wages and the business cycle as a simple measure of wage cyclical, I find that wages are mostly procyclical in emerging markets but acyclical for developed countries. The contemporaneous correlation coefficients exceed 0.40 in Chile, Czech Republic, Ecuador, Korea, Mexico, Slovak Republic and Taiwan. This is consistent with the finding in Agenor et al [2000], in which they document procyclical wages for five developing countries over a different sample period. In developed economies, the correlations between wage and output range from 0.44 for France to -0.34 for Denmark, and seven among fifteen countries demonstrate negative correlations. The 95% confidence intervals calculated on each Pearson correlation further confirms this striking contrast. The observation of cyclical wages in developed countries is consistent with the earlier literature on real wages and the business cycle. In the survey by Abraham and Haltiwanger [1995], they conclude that available empirical evidence of real wage cyclical is not conclusive about the direction nor the degree of cyclical wage movement in responding to business cycle fluctuations. The t-statistics reported in the bottom confirms that statistically there are significant differences in the relative wage volatility and wage procyclicality between the two country groups.

Figure 5 presents the pattern of cross-correlation between wages from period $t - 4$ to $t + 4$ and output at period t for the selected seven emerging economies and seven small open developed countries. The cross-correlation exhibits a hump for emerging economies but no systematic pattern for developed ones. This implies that in emerging economies, wages are generally responsive to business cycles. On average, wage lags the cycle by a quarter in emerging markets.

One concern with the evidence documented in Table 1 is the measurement error in emerging-market data at quarterly frequency. Table 2 reports the business cycle statistics using annual data on real wage and output over a longer time period¹¹. The annual evidence is generally consistent with the quarterly observations, but there are some discrepancies in the results. For instance, for Brazil and Taiwan, the annual wages are negatively correlated with output. This might be due to the differences in the data frequency and time periods. Also, in developed countries annual wages are more positively correlated with output than quarterly wages, while in emerging markets, the opposite is true. This suggests that wage adjustments take place at different frequencies in emerging markets and developed countries. Wages are likely to respond to output fluctuation at quarterly frequencies in emerging markets but at annual frequencies in developed economies. Another concern with Table 1 is the comparability of different datasets. Here we can compare the results using only

¹¹Data ranges from 1975 to 2004. All the variables are taken log and HP-filtered using parameter 6.25.

Table 1: Volatility and Correlation of Wage with Output

	Output		Overall Activity Wage			Manufacturing Wage		
	Mean	$\sigma(y)$	$\frac{\sigma(w)}{\sigma(y)}$	$\rho(y, w)$	95% conf.	$\frac{\sigma(w)}{\sigma(y)}$	$\rho(y, w)$	95% conf.
Emerging economies								
Argentina	428	3.04				1.38	0.24	(-0.14, 0.57)
Brazil	1216	2.39	2.67	0.13	(-0.13, 0.37)			
Chile	132	2.91	0.71	0.52	(0.28, 0.70)	0.71	0.45	(0.19, 0.66)
Czech Republic	155	1.53	1.90	0.45	(0.18, 0.66)	1.35	0.55	(0.30, 0.73)
Ecuador	42	2.28	3.51	0.56	(0.33, 0.72)			
Hong Kong	166	3.24	0.48	0.51	(0.28, 0.69)			
Israel	138	2.36	0.94	0.22	(-0.04, 0.45)	0.86	0.16	(-0.08, 0.40)
Korea	747	2.56	1.20	0.65	(0.56, 0.73)	1.50	0.75	(0.67, 0.85)
Mexico	831	2.41				1.91	0.41	(0.21, 0.57)
Philippines	287	0.83	1.60	-0.19	(-0.62, 0.31)			
Russia	1045	3.53	3.01	0.08	(-0.21, 0.38)			
Singapore	88	3.05	0.91	-0.06	(-0.33, 0.21)	0.36	0.05	(-0.26, 0.36)
Slovak Republic	61	1.01	3.55	0.48	(0.32, 0.61)	2.70	0.70	(0.53, 0.81)
Taiwan	407	2.23	0.83	0.43	(0.17, 0.63)	0.51	0.47	(0.24, 0.67)
Turkey	414	4.32				1.69	0.32	(0.05, 0.54)
Average	410	2.51	1.78	0.32	(0.07, 0.56)	1.29	0.41	(0.17, 0.62)
Weighted Avg.		2.71	2.03	0.31	(0.01, 0.54)	1.18	0.50	(0.24, 0.64)
Developed Economies								
Australia	412	1.16	1.03	-0.12	(-0.33, 0.09)	1.91	0.16	(-0.05, 0.36)
Austria	199	1.24	0.80	0.00	(-0.31, 0.31)	0.56	0.20	(-0.02, 0.40)
Belgium	246	1.45	0.45	0.06	(-0.16, 0.27)	0.48	0.00	(-0.22, 0.21)
Canada	712	1.31				0.60	-0.28	(-0.47, -0.08)
Denmark	135	1.74	0.28	-0.34	(-0.57, -0.06)	0.49	-0.07	(-0.28, 0.14)
France	1343	0.90	0.61	0.43	(0.24, 0.59)	0.60	0.44	(0.25, 0.60)
Germany	1834	1.84	0.76	-0.13	(-0.34, 0.10)	0.46	-0.01	(-0.22, 0.21)
Italy	1307	1.07	0.88	-0.27	(-0.46, -0.06)	0.87	-0.31	(-0.46, -0.10)
Japan	3027	1.25	0.81	-0.03	(-0.24, 0.19)	0.78	0.31	(0.10, 0.49)
Netherlands	385	1.09	0.62	-0.14	(-0.37, 0.11)	0.57	-0.15	(-0.38, 0.10)
New Zealand	66	2.11	0.48	-0.20	(-0.41, 0.03)	0.41	-0.32	(-0.52, -0.09)
Norway	129	1.67				0.74	0.15	(-0.07, 0.35)
Sweden	203	1.67	0.41	-0.02	(-0.33, 0.29)	0.90	0.19	(-0.03, 0.39)
United Kingdom	1368	1.14	0.76	0.27	(0.09, 0.45)	0.8	0.34	(0.13, 0.52)
United States	8138	0.96				0.58	-0.09	(-0.29, 0.13)
Average	1300	1.37	0.66	-0.04	(-0.27, 0.19)	0.72	0.04	(-0.17, 0.24)
weighted average		1.15	0.74	0.01	(-0.23, 0.26)	0.67	0.04	(-0.16, 0.24)
T-stat		4.48	3.37	3.55		2.34	3.94	

Notes: The variables are real GDP (y), real wage rate in all sectors and real wage rate in manufacturing sector (w). All series are deseasonalized if a significant seasonal component is identified. The series are taken logarithm first and filtered using Hodrick–Prescott filter with a smoothing parameter of 1600. All statistics are based on quarterly data 1985Q1:2005Q4 (although data are only available beginning in early 90s for many emerging market economies). Data sources: emerging economies, IFS, OECD, EIU, EMBI+, Neumeyer and Perri [2005]; developed economies, IFS, OECD. See data appendix for details. Weighted average is weighted by country size, average real GDP (in U.S. dollar) over the sample period. T-statistics reported are for running the mean comparison test across emerging economies and developed economies

Figure 5: Cross-correlation between Output and Wage

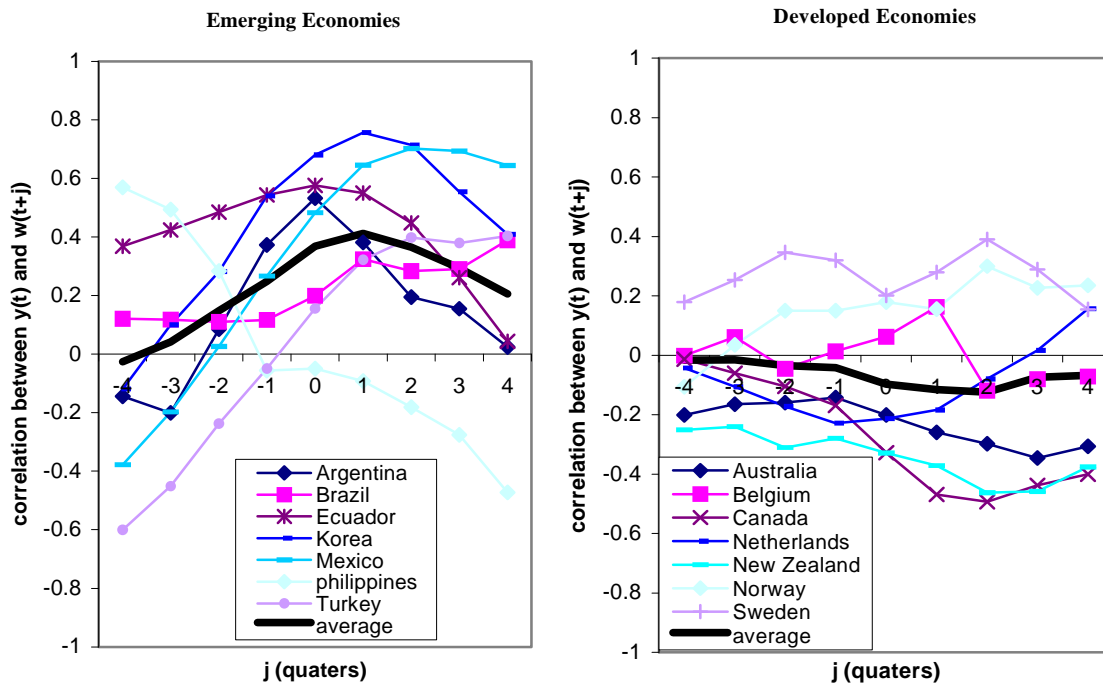
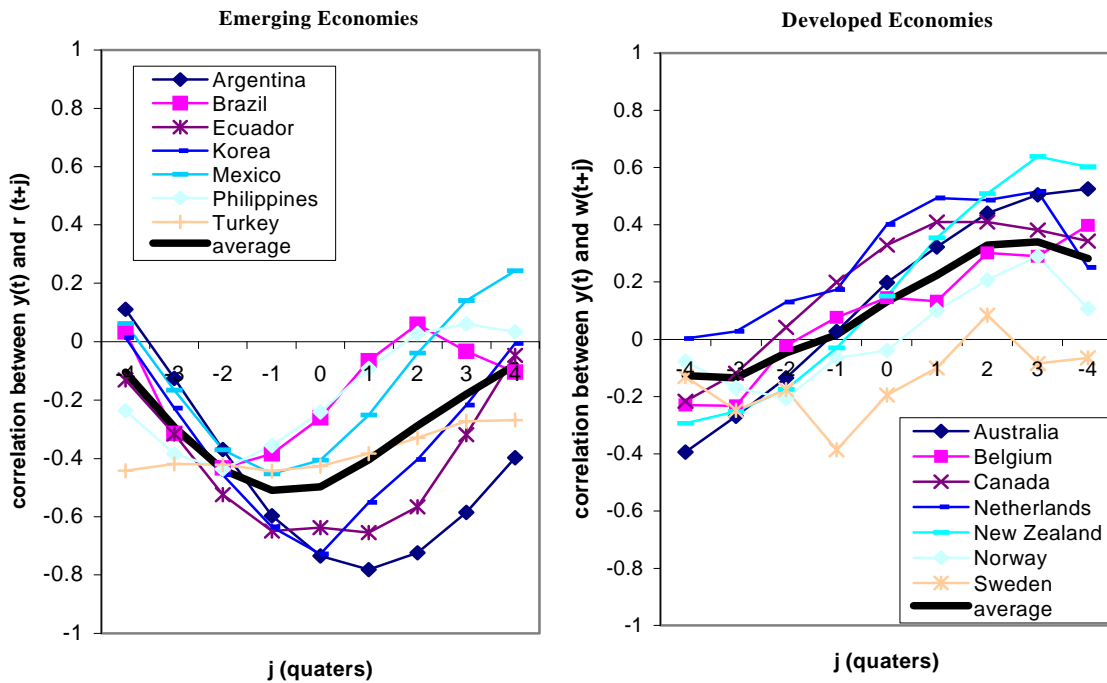


Figure 6: Cross-correlation between Output and Interest Rate



BLS data. The BLS provides annual data on hourly compensation costs for production workers in manufacturing for the period 1975-2005 for 33 countries, including six emerging market economies in the sample. The result suggests that the patterns are robust to this concern as well.

Table 3 and Figure 6 describe the cyclical behavior of real interest rates. It is evident that real interest rates are more volatile and countercyclical in emerging market economies, but procyclical or acyclical in developed countries. This finding was also documented by Neumeyer and Perri [2005], where they decompose the real interest rate into an international rate and a country risk component. When there is a downturn in the economy, country risk increases in emerging economies, raising interest rates as result. The evidence is also consistent with Kaminsky et al [2004]. They study the domestic real interest rates, i.e. the domestic nominal interest rate deflated by domestic inflation, and find that interest rates are countercyclical and monetary policies are procyclical in middle income countries, and the opposite is true for developed world. This paper does not aim to explain this phenomenon. But the literature has pointed to a few explanations¹². For example, the fear of a floating exchange rate makes monetary policy a function of international capital flow. Therefore, central governments are forced to raise interest rates to defend their currency when a significant amount of capital is leaving the country during bad times and vice versa. Other explanations involve interest rates as fiscal policy tools – during bad times governments need to issue more bonds to fund fiscal deficit and they raise interest rates to accommodate this demand.

Figure 7 and Figure 8 graphically demonstrate the relationships between wage flexibility and wealth level, and different measures of financial development. The Y -axis is the standard deviation of real wage as a ratio of the standard deviation of real GDP. There is clearly a negative relationship between relative wage flexibility and the level of financial development, regardless of the measure of financial development. Wages are more stable in wealthier countries. Also, the more open the capital market is in the country, the more stable the wage movement.

2.3 Discussions

One concern with the result is that it is based on the aggregated real wage data. The problem of using aggregate data is that it implicitly assumes that the composition of employment does not vary over the business cycle and that the cyclical real wage behavior is the same across sectors and individuals. In fact, Bils [1985] points out that ignoring the composition effect typically biases the real wage countercyclically. Because lower income workers (lower skilled and less work experienced) often have more procyclical wages, aggregation using individual income as a weight causes downward biases in the wage cyclicity. If this is the case, one would expect this effect of countercyclical bias is larger for poorer countries. Therefore, the individual real wage in emerging markets should be even more procyclical than in developed economics. However, the composition effect may help to explain the higher volatility in emerging market economies, considering the more dramatic entry and exit of lower income workers from the work force. This higher volatility of the extensive margin may cause

¹²See Calvo and Reinhart [2000], Kanczuk [2004] and Kaminsky et al [2004] for details.

Table 2: Volatility and Correlation of Wage with Output (annual data, 1975-2004)

	Output		Real Wage	
	$\sigma(y)$	$\sigma(w)$	$\frac{\sigma(w)}{\sigma(y)}$	$\rho(w, y)$
Emerging Economies				
Argentina	2.96	7.18	2.43	0.13
Brazil	0.85	1.67	1.96	-0.10
Chile	3.16	3.83	1.21	0.32
Czech Republic	1.87	1.98	1.06	0.19
Ecuador	1.62	6.27	3.87	0.36
Hong Kong*	2.32	1.93	0.83	0.16
Israel*	1.38	3.35	2.43	0.18
Korea*	2.31	3.78	1.64	0.48
Mexico*	2.39	5.12	2.14	0.43
Philippines	2.68	5.57	2.08	0.36
Russia	5.81	8.01	1.38	0.85
Singapore*	2.16	3.45	1.60	0.46
Slovak Republic	0.87	2.56	2.94	0.73
Taiwan*	1.39	1.39	1.00	-0.05
Turkey	3.75	6.06	1.62	0.54
Average (BLS)	1.99	3.17	1.61	0.28
Average	2.37	4.14	1.88	0.34
Developed Economies				
Australia	1.2	1.67	1.39	0.24
Austria	0.89	0.62	0.69	0.21
Belgium	1	0.79	0.79	0.12
Canada	1.35	0.99	0.73	-0.22
Denmark	1.14	1.21	1.06	0.14
France	0.76	0.98	1.28	0.4
Germany	1.53	0.93	0.61	0.11
Italy	0.85	0.89	1.04	-0.06
Japan	0.99	0.81	0.82	0.38
Netherlands	1.81	1.17	0.65	-0.13
Norway	1.12	1.38	1.23	0.44
Sweden	1.12	1.96	1.75	0.39
Switzerland	1.09	0.53	0.49	-0.2
United Kingdom	1.19	1.33	1.11	0.02
United States	1.26	0.98	0.77	0.13
Average (BLS)	1.19	1.08	0.96	0.13
t-stat	3.66	5.52	4.03	2.32

Notes: The variables are on annual frequency, for the period 1975-2004. The series are taken logarithm first and filtered using Hodrick–Prescott filter with a smoothing parameter of 6.25. Data sources: emerging economies: wage, BLS (countries with asterisk), IFS, UNIDO; CPI and real GDP, IFS; developed economies: wage, BLS; CPI and real GDP, IFS. See Appendix for detailed data sources. T-statistics reported in the end is by running the mean comparison test across the emerging economies and the developed economies.

Table 3: Volatility and Correlation of Real Interest Rate and Output

	Output	Real Interest Rate	
	$\sigma(y)$	$\sigma(r)$	$\rho(y, r)$
Emerging Economies			
Argentina	3.04	7.41	-0.66
Brazil	2.39	2.98	-0.38
Chile	2.91	4.67	0.27
Czech Republic	1.53	2.27	0.10
Ecuador	2.28	6.46	-0.64
Hong Kong	3.24	1.32	-0.03
Israel	2.36	1.23	-0.05
Korea	2.56	1.41	-0.73
Mexico	2.41	2.19	-0.48
Philippines	0.83	1.25	0.09
Russia	3.53	12.18	-0.42
Singapore	3.05	1.07	-0.03
Slovak Republic	1.01	2.11	0.47
Taiwan	2.23	1.10	0.17
Turkey	4.32	1.70	-0.37
Average (EMBI)	2.76	4.45	-0.45
Average	2.52	3.29	-0.18
Developed Economies			
Australia	1.16	1.87	0.29
Austria	1.24	1.07	0.3
Belgium	1.25	0.83	0.13
Canada	1.31	1.36	0.33
Denmark	1.74	1.46	-0.13
France	0.9	1.29	-0.24
Germany	1.84	1.05	-0.18
Italy	1.07	1.29	0.13
Japan	1.25	0.63	0.51
Netherlands	1.09	1.22	0.42
New Zealand	2.11	1.54	0.06
Norway	1.67	4.06	-0.04
Sweden	1.67	3.35	-0.19
United Kingdom	1.14	1.25	0.12
United States	0.96	0.95	0.66
Average	1.36	1.55	0.14

Notes: The variables are real GDP (y), real interest rate (r) in percentage points. All series are deseasonalized if a significant seasonal component is identified. The series are taken logarithm first and filtered using HP filter with a smoothing parameter of 1600. All statistics are based on quarterly data 1985Q1:2005Q4 for developed economies, and 1993Q1:2005Q4 for most emerging economies (except Argentina, Mexico, 1985Q1:2005Q4). Data sources: emerging economies, IFS, OECD, EIU, EMBI, Neumeier and Perri [2005]; developed economies, IFS, OECD. See data appendix for details.

Figure 7: Wage Volatility (Relative to Output) and Output per Capita

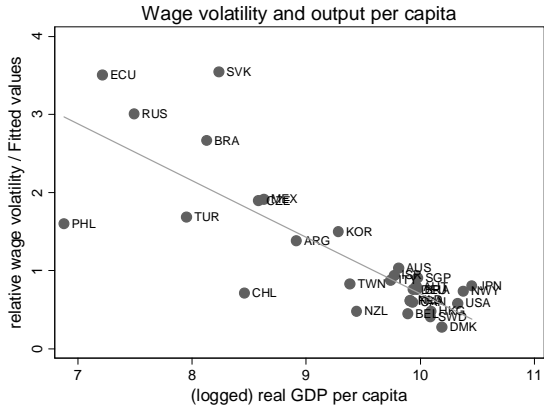
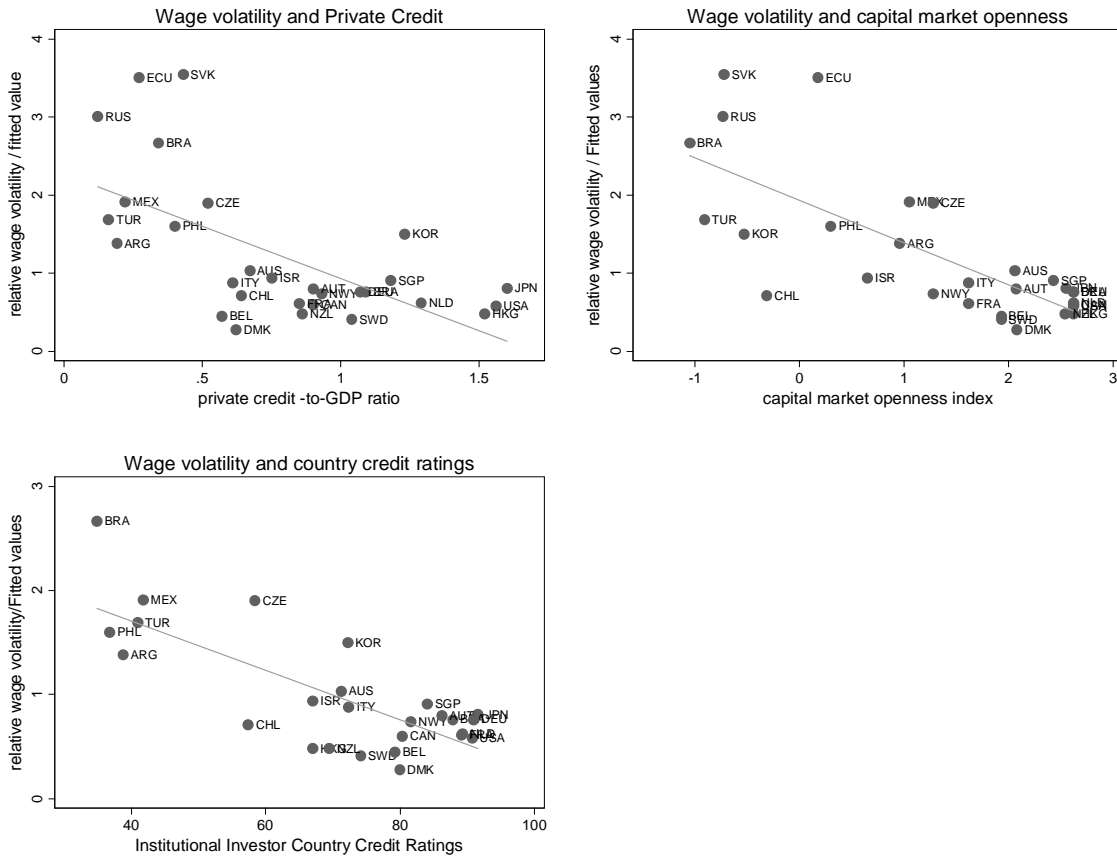


Figure 8: Wage Volatility (Relative to Output) and Financial Market Development



Data Source: private creditor by deposit money bank and other financial institutions over GDP, Beck Demigirc-Kunt and Levine [2005]; Capital Market Openness Index, Chinn and Ito [2005]; Country Credit Rating, International Country Risk Guide.

more volatile aggregate wage fluctuation in emerging markets compared to developed economies. Although important and interesting, given the limited data on the labor market conditions in emerging economies, the composition effect is not explored in this paper.

In the following sections, I analyze a labor contract model that helps to illustrate how the differential relationship of the interest rates and macroeconomic aggregates, and different levels of financial market development can account for the observed differences in wage fluctuations in emerging markets versus developed economies.

3 The Small Open Economy with Contract Labor Market

The model is a single-good, single-asset (a non-state contingent internationally traded real bond) small open-economy RBC model. It is augmented to include working capital and a labor contract between employers and workers.

Economic Environment Time is discrete, $t = 1, 2, \dots, \infty$. In each period t , the economy experiences one of finitely many states $s \in S$. Let $s^t = (s_1, s_2, \dots, s_t)$ denote the history for states up to time t . $\pi(s'|s)$ denotes the probability of transition from state s to state s' , which follows a Markov chain process. $\pi(s^t)$ is the probability of any history, s^t , as of period 0. $\pi(s^t) = \pi(s_t|s_{t-1})\pi(s_{t-1}|s_{t-2})\dots\pi(s_1|s_0)$. The state, s_t , specifies two shocks: the total factor productivity, $A(s_t)$ (an abstract composition of different types of shocks, e.g. technology shock, demand shock, exchange rate shock, etc.), and the real interest rate, $r(s_t)$, on bonds issued at time t and maturing at time $t + 1$. The state notation, s^t , is suppressed unless necessary. The only financial asset available is the internationally traded, one-period, non-state-contingent real bond. One unit of this bond purchased in period $t - 1$ guarantees the buyer $1 + r_{t-1}$ units of period t consumption goods.

The economy is inhabited by two types of infinitely lived agents, i.e. identical employers (also entrepreneurs, shareholders) and identical workers. The single output good that is used for both consumption and investment is produced by a Cobb-Douglas production function. It requires capital inputs (k_t) and labor services of both workers (l_t) and entrepreneurs (h_t):

$$y_t = F(k_t, n_t; A_t) = A_t k_t^\alpha n_t^{1-\alpha}$$

where $\alpha \in (0, 1)$ represents the capital share and n_t is the aggregate labor input - a CES composite of employer's labor service and workers' labor service:

$$n_t = [\eta(ml_t)^{1-\rho} + (1 - \eta)h_t^{1-\rho}]^{1/(1-\rho)}$$

where $0 \leq \eta \leq 1$, $\rho \geq 0$. $\frac{1}{\rho}$ reflects the elasticity of substitution between employer's labor input and worker's labor input. When $\rho \rightarrow 0$, the two types of labor inputs are perfect substitutes. Assume labor inputs by employers and workers are complementary, then $\rho > 1$. The number of employers is normalized to one and the representative employer employs $m(\geq 1)$ numbers of workers.

Capital accumulation follows the law of motion

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

where i_t is the investment expenditure at time t , δ is the depreciation rate and $\Phi(k_t(s^{t-1}), k_{t+1}(s^t))$ is the cost of adjusting the capital as a function of net investment, which takes a quadratic form

$$\Phi(k_t(s^{t-1}), k_{t+1}(s^t)) = \frac{\phi}{2}(k_{t+1}(s^t) - k_t(s^{t-1}))^2, \quad \phi > 0$$

Hence, at the non-stochastic steady-state, the adjustment cost is zero and the domestic interest rate equals the marginal product of capital net of depreciation. The capital adjustment cost is usually included in small open economy models to avoid excessive volatility in capital investment in response to fluctuations in international interest rates over the domestic interest rates.

Each employer values the stochastic sequences of utility generated by consumption c_t^E and leisure $(1 - h_t)$ and his utility function is given by $v(c_t^E, h_t)$. Each worker has preferences over consumption, c_t^W , and leisure $(1 - l_t)$, described by $u(c_t^W, l_t)$. I focus on a consumption-leisure separable utility function for most of the paper. Workers and employers have utility functions given by $u(c^W, l) = \frac{(c^W)^{1-\sigma}}{1-\sigma} + b\frac{(1-l)^{1-\nu}}{1-\nu}$ and $v(c^E, h) = \frac{(c^E)^{1-\varsigma}}{1-\varsigma} + f\frac{(1-h)^{1-\psi}}{1-\psi}$. For comparison, I also consider other two functional forms for preferences: the Cobb-Douglas utility function and the utility form proposed by Greenwood, Hercowitz and Huffman (GHH). Cobb-Douglas utility functions are given as $u(c^W, l) = \frac{[(c^W)^\nu(1-l)^{1-\nu}]^{1-\sigma}}{1-\sigma}$ and $v(c^E, h) = \frac{[(c^E)^\psi(1-h)^{1-\psi}]^{1-\varsigma}}{1-\varsigma}$. GHH utility functions are $u(c^W, l) = \frac{[(c^W)-bl^\nu]^{1-\sigma}}{1-\sigma}$ and $v(c^E, h) = \frac{[(c^E)-fh^\psi]^{1-\varsigma}}{1-\varsigma}$.

Labor Contract Employers own capital and have access to capital and financial asset markets, whereas the more risk-averse workers are not shareholders or savers and do not have access to those markets to borrow or lend out of their labor income. In other words, workers supply labor service and are “hand-to-mouth” consumers. Therefore, $c_t^W = w_t l_t$. This assumption is not supposed to be taken literally and is not crucial. The result should maintain as long as workers cannot access the financial market to independently smooth consumption to the extent that employers can. It provides a mechanism that motivates the risk-sharing labor contract. On the other hand, there is extensive evidence that a large portion of financial trading and risk-management is conducted by a small fraction of agents. Typical households hold few stocks and participate in only a limited number of financial markets¹³. Financial frictions such as asymmetric information, monitoring costs, and the fixed cost of participation may all lead to limited participation in financial markets by households. Moreover, especially for emerging countries, borrowing to smooth consumption over time is limited for most households since future labor income is highly uncertain and not very useful for collateralizing loans.

As in most implicit contract literature, the important feature of the optimal arrangement de-

¹³For example, Mankiw and Zeldes [1991] find that only one-fourth of U.S. households own stocks and of those with liquid assets in excess of \$200,000, only 47.7% hold any stocks.

depends on the assumption that workers are more risk averse than employers, i.e. $-\frac{v_{cc}(c_t^E, h_t)c_t^E}{v_c(c_t^E, h_t)} < -\frac{u_{cc}(c_t^W, l_t)c_t^W}{u_c(c_t^W, l_t)}$ ¹⁴. Risk-averse workers would like to insure themselves against potential income fluctuations, but are unable to do so directly through asset markets. The labor contract provided by employers includes an insurance component to wage payments, which helps to break the link between wage and the marginal product of labor.

Employers have to borrow a fraction, θ (≥ 0), of the wage bill as working capital, before hiring labor services and physical capital to produce the final good. This working-capital loan is subject to the interest rate in the last period, r_{t-1} . Let z_t denote the amount of working capital held by the representative employer. Then, we have

$$z_t \geq \theta w_t l_t$$

The employer's profit equals output plus the net debt income, less wage payments, working capital repayments with interest, and investment costs:

$$\pi_t = F(k_t, l_t, h_t; A_t) + [d_t - d_{t-1}(1 + r_{t-1})] - w_t l_t - r_{t-1} z_t - i_t$$

in which d_t is the net debt position of the firm. At the optimum, the working capital constraint always binds, since it is resource-costly. Substituting $z_t = \theta w_t l_t$ into the above equation, we have the following profit formula for the employer

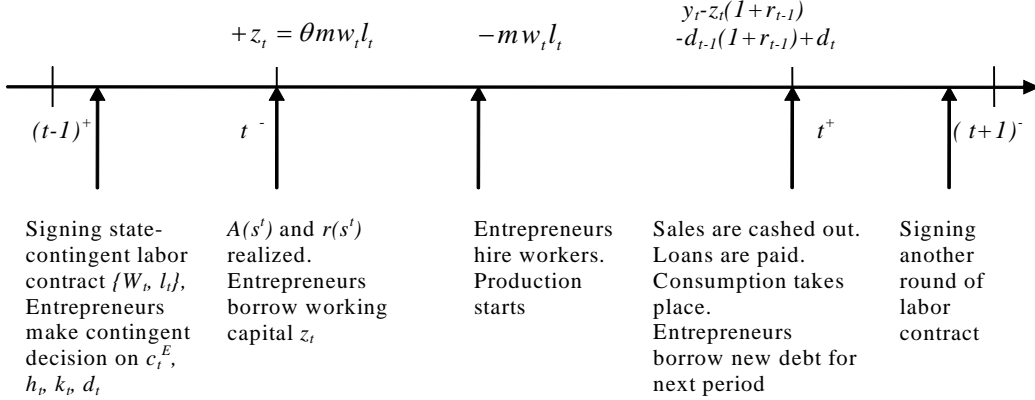
$$\pi_t = F(k_t, l_t, h_t; A_t) + [d_t - d_{t-1}(1 + r_{t-1})] - w_t l_t (1 + \theta r_{t-1}) - r_t^k k_t \quad (1)$$

The working-capital constraint increases the cost of employing labor by a fraction of θr_{t-1} , and an increase in r_{t-1} raises the unit labor cost and depresses the demand for labor. When $\theta = 0$, interest rate changes induce no demand-side effect of input, but only affect the employer's saving decision. The model reduces to the basic small open economy model.

At the end of each period, employers and workers sign a one-period-ahead wage-hours contract before the state of the world is known. All the information is public and once the employers and workers get together, they stick with the other party for the rest of time. The decision problem can be described along the following time line, as described in Figure 9. The flow of income (or cost) throughout period t is shown on top of the time line. Given the current state s^{t-1} at time $t - 1$ and the asset positions k_t, d_{t-1} of employers, employers and workers decide on a labor contract, which specifies a full spectrum of state-contingent salaries and hours worked $\{W(s^t), l(s^t)\}$ for the next period t , where $W = wl = c^W$. Simultaneously, employers make state-contingent plans for their own consumption, labor effort and investment decisions and workers make state-contingent decisions on consumption and labor input. The decision process can be broken down into two optimization problems, as follows. The production process is carried out within one period. After

¹⁴This can be rationalized in various ways. For example, occupational selection suggests that entrepreneurs are often less risk-averse than average people. Empirical studies also find evidence suggesting that the group of non-shareholders is considerably more risk averse than shareholders.

Figure 9: Timeline



shocks, $A(s^t)$ and $r(s^t)$, are revealed at time t , wage compensation predetermined by the contract is fixed, and entrepreneurs borrow working capital, z_t , from banks to cover the labor cost. The principle and interest on working-capital loans must be repaid to banks at the end of period t . Production is thereafter carried out and sales are cashed out at the end of the period. Employers also pay back the debt from last period, $d_{t-1}(1+r_{t-1})$ and borrow d_t amount of new debt from the bank and carry it over to the next period.

The employer's source of consumption is the profit, that is output plus the net debt income, less wage payments, working capital payment with interest, and investment cost. So his budget constraint is given by

$$c_t^E + i_t - d_t \leq F(k_t, m l_t, h_t; A_t) - m w_t l_t (1 + \theta r_{t-1}) - d_{t-1} (1 + r_{t-1})$$

Taking the equilibrium values of c_t^E, h_t, i_t and d_t parametrically for the time being, the contract at time $t-1$ maximizes the weighted average of expected utility of employers and workers as follows:

$$\begin{aligned} \max_{w_t, l_t} \quad & E_{t-1} \{ \mu [v(c_t^E, h_t) - \bar{v}] + (1 - \mu) [u(c_t^W, l_t) - \bar{u}] \} \\ \text{s.t.} \quad & c_t^E + i_t - d_t \leq F(k_t, m l_t, h_t; A_t) - m w_t l_t (1 + \theta r_{t-1}) - d_{t-1} (1 + r_{t-1}) \\ & c_t^W \leq w_t l_t = W_t \end{aligned} \tag{2}$$

Where \bar{u} is the reservation utility for employers and \bar{v} for workers. There is a preassigned bargaining power for each party (μ for entrepreneur and $1 - \mu$ for all the workers together) that does not vary with states. Because for simplicity, it is assumed that both parties are fully committed to the employment relationship. Or, quitting or firing is prohibited through the intervention of a third party. The outside option does not affect the bargaining weight¹⁵. This bargaining weight is chosen

¹⁵Some other interesting dynamics may arise if one allows entrepreneurs or workers to end the contract when better outside opportunities exist and labor contracts have to be self-enforcing. For the purpose of this paper, I do not

such that at the steady state, both employers and workers get the same utilities as if they traded labor service at the spot labor market (see Appendix C for specification of the alternative spot labor market in this framework).

Since $c^W = W$, the labor contract specifies wage payment and hours worked for each worker in the next period: $\{W(s^t), l(s^t)\}$. The first-order-condition with respect to W_t generates the risk sharing employment relationship:

$$\mu m v_c(c_t^E, h_t)(1 + \theta r_{t-1}) = (1 - \mu) u_c(W_t, l_t) \quad (C1)$$

The first-order-condition with respect to labor input l_t , together with the above equation, generates the familiar efficiency condition stating that the marginal rate of substitution between consumption and leisure equals the marginal product of labor modified by financial cost of hiring labor $(1 + \theta r_{t-1})$:

$$\frac{F_{l,t}}{m(1 + \theta r_{t-1})} = -\frac{u_l(W_t, l_t)}{u_c(W_t, l_t)} \quad (C2)$$

The sequence of contracted wage payments and labor inputs, $\{W(s^t), l(s^t)\}$, is fully characterized by the above *risk sharing condition* (C1) and *contracted efficiency condition* (C2).

Unlike in the spot labor market, the wage is now decoupled from marginal labor productivity, and does not have to be completely associated with the marginal rate of substitution either. Moreover, the risk sharing employment relationship is generally not satisfied by the spot equilibrium allocation. Note that without the working capital requirement, $\theta = 0$, the ratio between employer's marginal utility of consumption and the worker's marginal utility of consumption equals the constant ratio of bargaining weights $\frac{(1-\mu)}{\mu m}$ in all states $s_t \in S$. The consumption of workers is perfectly correlated with the consumption of employers in all states. Specifically for $\forall s_t^i \neq s_t^j$,

$$\frac{v_c(c_t^E(s_t^i), h_t(s_t^i))}{u_c(c_t^W(s_t^i), l_t(s_t^i))} = \frac{v_c(c_t^E(s_t^j), h_t(s_t^j))}{u_c(c_t^W(s_t^j), l_t(s_t^j))}$$

When preferences are completely separable in consumption and leisure, worker's consumption comoves perfectly with employer's consumption. Hence, implied by the implicit contract theory, the risk sharing employment relationship, in general, helps to smooth labor income (consumption) for workers compared with spot labor market, when the employer smooths his consumption intertemporally through the asset market.

Moreover, if $\theta > 0$, the working capital requirement imposes a wedge $(1 + \theta r_{t-1})^{-1}$ between employer's marginal utility of consumption and the worker's marginal utility of consumption. The wedge decreases with the cost of borrowing working capital $(1 + \theta r_{t-1})^{-1}$, and increases with the real interest rate r_{t-1} . Therefore, in emerging economies, during economic downturns, real interest rates rise, making workers' consumption more costly. Through the risk sharing condition, this implies a larger drop in the worker's consumption compared to the employer's, equivalently, a large

examine these situations.

decrease in worker's wage compensation.

To complete the specification of the optimal allocation, let $\{W_t^*, l_t^*\}$ denote the optimal contract that is characterized by C1 and C2. Implied by the Envelope Theorem, the employer at the same time decides his own labor effort, consumption, capital investment and borrowing by solving

$$\begin{aligned} V(s^t, k_t; W_t^*, l_t^*) &= \max_{h_t, c_t, k_{t+1}, d_t} v(c_t^E, h_t) + \beta E_t V(s^{t+1}, k_{t+1}; W_{t+1}^*, l_{t+1}^*) \\ \text{s.t. } c_t^E + i_t - d_t &\leq F(k_t, ml_t^*, h_t; A_t) - mW_t^*(1 + \theta r_{t-1}) - d_{t-1}(1 + r_{t-1}) \end{aligned} \quad (3)$$

The optimal choices in the equilibrium are characterized by efficiency condition on employer's labor supply

$$-\frac{v_h(c_t^E, h_t)}{v_c(c_t^E, h_t)} = F_h(k_t, ml_t^*, h_t; A_t)$$

The Euler equations are

$$\begin{aligned} 1 + \phi(k_{t+1} - k_t) &= E_t \beta \frac{v_c(c_{t+1}^E, h_{t+1})}{v_c(c_t^E, h_t)} (F_k(k_{t+1}, ml_{t+1}^*, h_{t+1}; A_{t+1}) + (1 - \delta) + \phi(k_{t+2} - k_{t+1})) \\ 1 &= E_t \beta \frac{v_c(c_{t+1}^E, h_{t+1})}{v_c(c_t^E, h_t)} (1 + r_t) \end{aligned}$$

The no ponzi scheme condition is given by

$$\lim_{j \rightarrow \infty} E_t \frac{d_{t+j}}{\prod_{\tau=t}^j (1 + r_\tau)} \leq 0$$

Interest Rates and Financial Sectors Section 2 shows that interest rate fluctuations display different patterns in developed and emerging economies. There is no single theory of interest rate movements for both types of economies. In this section, I provide some simple explanations of cyclical interest rate movements, but formally modeling the interest rate fluctuation is not the focus of this paper. The interest rate process is divided into two parts in the model: an exogenously determined component and an endogenously determined component.

$$r_t = r_t^* + \kappa [\exp(d_t/y_t - \bar{d}) - 1] \quad (4)$$

in which r^* is the exogenous interest rate component. \bar{d} , denotes the steady state level of debt as a fraction of output, and κ governs the elasticity of interest rates to changes in net debt position. The second term in (4) characterizes the risk premium in the interest rate faced by domestic agents as a function of net external debt position. The representative agent does not take into account the impact of changing his debt position on the real interest rate when choosing the optimal debt position.

Explanations of the exogenous component in real interest rate differ between emerging markets and developed economies. For developed economies, central banks take the role of "the rest of the world" and interest rates reflect monetary policy shocks. Central banks from rich countries adjust

interest rates as part of their endogenous monetary policies. That is, during the economic downturns, expansionary-monetary-policy shocks by the central bank through the open market operation generate decreases in nominal interest rates to boost the employment and output. Therefore, r_t^* is procyclical. From the viewpoint of economic individuals, r_t^* , is taken exogenously.

In contrast, emerging markets borrow heavily on external financial markets and tend to experience economic crises more frequently than developed economies. The large output volatility is often accompanied by large changes in capital flows, and interest rates on these dollar-denominated assets are determined by foreign investors. Therefore, international credit conditions are important. As happened in many “original-sin” countries, during an economic boom, capital rushes to these countries, inducing a lower interest rate. When the economy slows down, loans to the emerging markets become more risky, since the perceived default risk increases. Therefore, foreign investors would charge a higher interest rate incorporating the rising country risk.

The endogenous component plays two roles. First, it is typically assumed in small open economy models to induce stationarity in the equilibrium dynamics (see Schmitt-Grohe and Uribe [2003]). Second, it can be decentralized as follows. Most domestic firms in emerging markets, especially small and medium sized ones, do not have direct access to international financial markets. Banks, as financial intermediates, borrow from external financial market at interest rate r_t^* , and lend to domestic agents at interest rate r_t . The larger the volume of funds under intermediation, the higher the unit cost of financial intermediation (e.g. monitoring cost, information cost, transaction cost, etc.). However, individual banks do not internalize this cost. The bank maximizes the end-of-period profit

$$r_t \tilde{d}_t - r_t^* \tilde{d}_t - \tilde{d}_t \kappa [\exp(d_t/y_t - \bar{d}) - 1]$$

by choosing their individual loans, \tilde{d}_t and κ reflects the unit cost of intermediation. In the calibration section, a lower κ reflects a higher financial development level. The solution of this optimization problem is given by equation (4).

Equilibrium allocation and prices Given the initial condition S_0, k_0 and d_0 , and a sequence of realizations of shocks to interest rates $\{r(s^t)\}_{t=0}^{\infty}$ and productivity $\{A(s^t)\}_{t=0}^{\infty}$, a competitive equilibrium in a small open economy with contract labor market is a state-contingent sequence of allocations $\{c^W(s^t), c^E(s^t), l(s^t), h(s^t), k(s^t), d(s^t)\}_{t=0}^{\infty}$, and a sequence of wages $\{w(s^t)\}_{t=0}^{\infty}$, such that (a) the optimal wage and labor schedule $\{w^*(s^t), l^*(s^t)\}$ solve (2) for all states given $\{c^E(s^t), h(s^t), k(s^t), d(s^t)\}$; and (b) $\{c^E(s^t), h(s^t), k(s^t), d(s^t)\}$ solve (3) and (c) factor market and goods market clear

$$c_t^E + mc_t^W + i_t + tb_t = y_t$$

where the trade balance $tb_t = d_{t-1}(1 + r_{t-1}) - d_t - m\theta W_t r_{t-1}$.

4 Characterization of equilibrium

4.1 A Discussion of spot labor market versus contract labor market

In the standard RBC model of a closed economy, the spot labor market model performs poorly in mimicking the statistical properties of wage movements and labor market fluctuations¹⁶. This is also true of open economy RBC models. Since the wage is linked closely to productivity shocks, the correlation between wages and output is unrealistically high. This evidence implies that a departure from the Walrasian labor market setup is necessary in order for the model to be consistent with wage adjustments.

Equilibrium with the spot labor market With the spot labor market, the real wage equates with both the marginal product of labor and the marginal rate of substitution between consumption and leisure. With the additively separable utility function specified in the previous section, this means

$$MP_t^r = w_t = bc_t^\sigma(1 - l_t)^{-\nu} \quad (5)$$

where $MP_t^r = (1 - \alpha)A_t^r k_t^\alpha l_t^{-\alpha} = (1 - \alpha)A_t^r k_t^\alpha l_t^{-\alpha} / (1 + \theta r_{t-1})$, is defined as the “modified marginal product of labor”. This financial cost of hiring labor increases with the interest rate by a magnitude depending on the fraction of wage payment due in advance, θ . An increase in the interest rate enlarges employer’s borrowing cost of working capital, reducing the labor demand. Hence, the interest rate shock in a spot labor market model affects the labor input and wage choice in the same manner as a productivity shock does. Therefore, a countercyclical interest rate shock simply amplifies the productivity shock in a spot labor market.

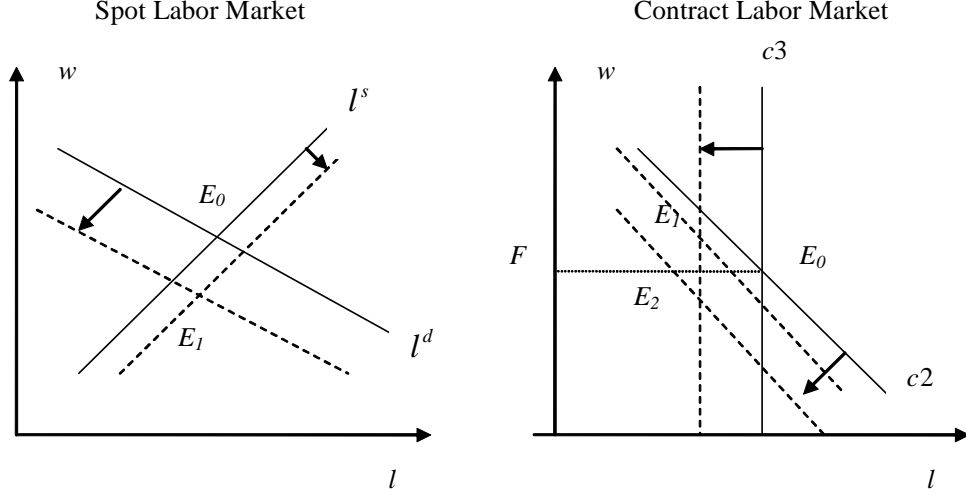
The two equations in (5) specify the labor supply equation and the labor demand equation respectively. As depicted in the left panel of Figure 10, the upward sloping line stands for the labor supply curve and the downward sloping line specifies the labor demand curve. In this scenario, a decrease in labor productivity, or an increase in the interest rate leads the labor demand curve to move towards the origin. Since the drop in wage also implies an income effect that dampens the substitution effect, the shocks also lead to an outward shift of the labor supply curve. The final effect on the equilibrium wage is definitely negative, but the effect on equilibrium employment can be either positive or negative. Defines $\hat{x} = \log \frac{x}{\bar{x}}$. Analytically, the linearized equilibrium labor input is given by

$$\hat{l}_t = \frac{\hat{A}_t^r + \alpha \hat{k}_t - \sigma \hat{c}_t}{\tilde{\nu} + \alpha} \quad (6)$$

where $\tilde{\nu} = \frac{\bar{l}}{1-\bar{l}}\nu$ represents the inverse of the Frisch elasticity of labor supply and \bar{l} is the steady-state value of employment. With the labor demand elasticity ($1/\alpha$) given, the effect of a productivity shock and an interest rate shock depends on the response of consumption, \hat{c}_t , the risk aversion coefficient, σ , and the labor supply elasticity, $1/\tilde{\nu}$. If workers are highly risk-averse and the labor supply elasticity is small (as indicated by the microeconomic evidence), the sensitivity of labor

¹⁶See a survey by Abraham and Haltiwanger [1995] on cyclical real wage in the U.S.

Figure 10: Equilibrium wage and employment under spot labor market and labor contract



input to shocks is low, because the income effect offsets the substitution of the wage reduction. The wage, however, varies closely with productivity shocks or interest rate shocks. Because the wage is tightly linked to the marginal product of labor, the spot labor market always predicts an excessively high correlation between wage and output, which is inconsistent with the data. The solution is to replace the spot labor market with the risk sharing labor contract.

Equilibrium with contract labor market The insurance component embedded in a contract labor market dissociates wages from the marginal productivity of labor. The equilibrium wage-employment relationship is characterized by the contracted efficiency condition (C1) and the risk sharing condition (C2). Taking the separable utility function specified in section 3 as an example, these two conditions are given by

$$\begin{aligned}
 C1 & : & (1 - \alpha)A_t k_t^\alpha n_t^{\rho - \alpha} \eta m^{1 - \rho} l_t^{-\rho} / (1 + \theta r_{t-1}) &= b(c_t^W)^\sigma (1 - l_t)^{-\nu} \\
 C2 & : & \mu m (c_t^E)^{-\varsigma} (1 + \theta r_{t-1}) &= (1 - \mu)(c_t^W)^{-\sigma}
 \end{aligned}$$

The ratio of an employer's marginal utility of consumption to a worker's marginal utility of consumption is equal to $\frac{1 - \mu}{m\mu(1 + \theta r_{t-1})}$, a decreasing function of the interest rate.

Suppose that the labor supply elasticity of workers and employers are the same. Then $\hat{n}_t = \hat{h}_t = \hat{l}_t$. Now log-linearizing (C1) and (C2) around the steady states yields (see Appendix for derivation)

$$\begin{aligned}
 C1 & : & \hat{w}_t + \hat{l}_t &= \frac{\tilde{\nu} + \alpha}{\sigma} \hat{l}_t + \frac{\hat{A}_t + \alpha \hat{k}_t}{\sigma} - \frac{\tau}{\sigma} \hat{r}_{t-1} \\
 C2 & : & \hat{w}_t + \hat{l}_t &= \frac{\varsigma}{\sigma} \hat{c}_t^E - \frac{\tau}{\sigma} \hat{r}_{t-1}
 \end{aligned}$$

where $\tau = \frac{\theta \bar{r}}{1 + \theta \bar{r}}$, an increasing function of θ . Combining C1 and C2 and rearranging the terms, we

obtain $C3$

$$C3: \quad \hat{l}_t = \frac{\hat{A}_t + \alpha \hat{k}_t - \varsigma \hat{c}_t^E}{\tilde{\nu} + \alpha}$$

This is similar to the standard equilibrium labor determination (as in equation (6)), only that the income effect is captured by employer's consumption, c_t^E , and employer's risk-aversion coefficient, ς , instead of worker's own consumption. Usually, when employers do not care about risk too much, ς can be very small, and the income effect is repressed. Labor would be responsive to the underlying productivity shock and strongly correlated with output.

Plot $C2$ and $C3$ in Figure 10. The labor determination schedule is the vertical line and the risk sharing line is downward sloping. In contrast to a spot labor market where the interest rate only acts as a labor demand shock, an interest rate shock in the contract labor market also affects the risk sharing condition. Suppose the emerging-market economy is hit by a negative productivity shock, accompanied by a rise in real interest rate. Through its intertemporal substitution effect, an interest rate shock also induces a reduction in equilibrium consumption for risk-averse agents. Starting from an initial equilibrium E_0 , as long as the income effect does not completely offset the substitution effect, the negative productivity shock shifts $C3$ to the left. At the same time, the decrease in consumption and positive interest rate shock shift $C2$ to the left. Depending on the specification of parameters and the interaction and magnitude between productivity shock and real interest rate shock, the new equilibrium can end up above the horizontal FE_0 line (equilibrium E_1) or below the FE_0 line (equilibrium E_2).

4.2 The Role of Interest Rates

Interest rate fluctuations affect wages through two channels. First, through the working capital constraint, the interest rate directly affects the cost of financing the wage bill, making wage payment sensitive to the interest rate. Specifically, in emerging economies, when output drops, the interest rate rises, increasing the financial cost of hiring labor. This makes workers' consumption more expensive. Other things equal, implied by ($C3$), the optimal wage payment drops. The second channel is through the intertemporal substitution effect. In an open economy, smoothing or substituting consumption intertemporally is achieved via changes in the current account. Therefore, the external interest rate fluctuation induces changes in the saving behavior. During economic recession, the interest rate increases. Entrepreneurs would like to save more and make workers work harder. Hence, the optimal contract would specify a smaller reduction in the labor input during the economic downturn. As implied by equation ($C3$), the consequence is that the labor input is not very responsive, while the wage is exposed to more volatility and displays higher procyclicality.

5 Calibration

In this section, I introduce specific functional forms and calibrate parameter values that are used to investigate the quantitative implications of the model. The model is considered at a quarterly

frequency. The data from Mexico (1994:1-2005:4) and Canada (1985:1-2005:4) is used to estimate some parameters governing stochastic shocks, preferences, production and adjustment costs. Finally, the implications of the labor market structure and the effect of interest rates and financial market developments are assessed by several computational experiments.

5.1 Parameter Specification

The parameter values are determined based on either (i) existing literature, (ii) the prior information derived from data about their range or magnitude, or (iii) the implied deterministic steady-state values for some endogenous variables consistent with their average values for the data in the sample period 1993:1-2005:4. Preferences are governed by $(\beta, f, \sigma, \nu, b, \varsigma, \psi)$, the production technology by (α, ρ, η, m) , capital accumulation by (ϕ, δ) . The entrepreneur's bargaining power parameter is μ , one parameter relates to the interest rate, κ , and lastly, the fraction of labor income required to be paid in advance is given by θ .

The benchmark parameters are listed in Table 4. The discount factor β varies according to which interest rate is used. It equals 0.98 to match the EMBI+ spread generated real interest rate of 8.15% per year for Mexico over the sample period, and 0.99 when the model is calibrated to Canada to match the average 3.85% annual real interest rate. σ and ς specify the risk aversion levels of workers and employers respectively. As preferences are separable in consumption and leisure and workers are assumed to be more risk averse than entrepreneurs, $\sigma > \varsigma$. The worker's risk aversion parameter is set to 2, and the employer's risk aversion coefficient is set to 1.5 arbitrarily, so that employers are less risk averse than workers. The results vary substantially when risk averse coefficient for employers are lower than 1.3.

The appropriate value for the intertemporal labor supply elasticity is a bit controversial. Micro-economic evidence on this parameter is generally based on developed country - U.S. observation. They show that intertemporal (Frisch) elasticity of labor elasticity is rather small. For example, Pencavel [1986] reports the value is around 0.2. While these estimates are mostly based on the assumption that wages are set in spot labor market, other labor market arrangements give different labor supply elasticity. For example, Beaudry and DiNardo [1995] suggests a higher labor elasticity about 0.8 is a reasonable value for men, when estimating the labor supply equation under the assumption of long-term employment relationship. Blundell and Macurdy [1999] estimate the intertemporal elasticity of labor supply to be in range [0.5, 1]. The leading contribution to estimation of this parameter is by Pistaferri [2003]. Using data on workers' personal expectations of wage change, he finds the elasticity to be 0.69. Therefore, for the case of GHH and additively separable preferences, I choose parameter ν and ψ such that the intertemporal elasticity of labor supply is 0.69 for workers and 0.75 (the medium value of Blundell and Macurdy [1999]) for employers¹⁷.

The technology parameter α is set to be 0.32 as in Mendoza [1991]. Golin [2002] also shows that after several adjustment including self-employment, labor shares for most countries ranges

¹⁷In GHH, ν is one plus the inverse of intertemporal (Frisch) elasticity of labor supply; for separable utility function, ν equals $\frac{1-\bar{l}}{\bar{l}}$ over intertemporal elasticity of labor supply, where \bar{l} is steady-state level labor input.

from 0.65 to 0.80, leaving α in the range of 0.2 to 0.35. The depreciation rate, δ , is chosen to be 0.025, which correspond to 10% annual depreciation rate. m specifies the number of workers that work with one employer. By this definition, m can be a large number. However, more importantly in the model, the representative employer is also the one whose consumption is not constrained strictly by labor income. Campbell and Mankiw [1989] present empirical evidence suggesting that the fraction of workers with consumption following income growth is about 50%. I follow Boldrin and Horvath [1995] and set $m = 1.5$ for the baseline model. In addition, this choice of m implies that in the economy, 40% of the population are entrepreneurs, or those whose consumption does not have to vary with labor income.

With m determined, we can move on to fix the other parameters in the aggregated labor input function. The parameters η and ρ determine the relative value of the two types of labor inputs in the aggregated production function. Specifically, η specifies the weight of labor input by all the workers in total labor service and $1/\rho$ controls the marginal rate of substitution between entrepreneur's and workers' labor inputs. In order for these two types of labor inputs to be complementary instead of substitutable production factors, ρ should be larger than one. I choose $\rho = 1.5$ arbitrarily, so that workers' and entrepreneur's labor services are complementary. Given the magnitude of m and ρ , the value for η is chosen such that, in the steady state, the income of the entrepreneur corresponds to the average income received by top 40% of the entire population in the sample. Lacking direct empirical evidence on the matter, I adopt the methodology used by Gomme and Greenwood [1995], and estimate that on average, the top 40% of the population earned 1.46 times as much as the bottom 60% in Mexico for the year 1996 (see Appendix for the details of estimation). Consequently, the labor share of the workers, η , is calibrated to be 0.456.

With the production parameters chosen, the rest of the preference parameters are estimated to match this average ratio of hours worked to total nonsleeping hours of the working age population. According to OECD Annual Hours and Productivity data, the average worker in Mexico works 1888 hours per year in year 2002. This implies that workers spend, on average, about 32% of their nonsleeping hours on market activities. This percentage was estimated to range between 24% to 33% in the developed economies by various authors. Based on this evidence, f is set to 1.394 and b is 7.529 in the case of the separable utility function so that in a steady state $h = l = 0.30$. For the case of the Cobb-Douglas utility function, $\nu = 0.342$ and $\psi = 0.324$.

In addition, the working capital parameter, θ , is chosen to be 1.5. This means an employer has to keep a level of 4 months and 2 weeks of wage payments as working capital every quarter. In the benchmark model, the capital adjustment cost parameter ϕ and debt adjustment parameter, κ , are set so that the relative volatility of output and volatility of trade-to-GDP ratio are close to the data. Using data provided by Lane and Milesi-Ferretti [2006], the steady-state level of the net external debt position, \bar{d} , is 44% in Mexico and 25% in Canada over the sample period. Finally, the entrepreneur's bargaining weight is chosen such that his utility in the presence of contracting with workers is no less than what it would be in a Walrasian world at steady state. Depending on the specification of the utility function, the bargaining weight is estimated to be between 0.870

Table 4: Parameters

Description	Symbol	Values		
Preference parameters				
Discount factor	β	0.98 (Mexico), 0.99 (Canada)		
Utility function		Separable	CD	GHH
Employer				
Labor Weight	f	1.394	1	1.248
Risk averse	ς	1.5	1.5	1.5
Labor elasticity	ψ	2.667	0.324	2.333
Worker				
Labor weight	b	7.527	1	2.572
Risk averse	σ	2	2	2
Labor elasticity	ν	2.897	0.342	2.449
Bargaining power	μ	0.885	0.87	0.877
Technology and other parameters				
Capital exponent	α	0.32		
Workers' share of labor input	η	0.456		
Elasticity of substitution	ρ	1.5		
between employer's and worker's labor				
Number of worker per employer	m	1.5		
Depreciation rate	δ	0.025		
Other parameters				
% labor income paid in advance	θ	1.5		
Capital adjustment cost	ϕ	varies		
Debt adjustment cost	κ	varies		
Steady-state debt to GDP ratio	\bar{d}	0.44 (Mexico), 0.25 (Canada)		

and 0.885, implying a much higher weight on the entrepreneur. This is reasonable giving that the entrepreneur is the only one with accessibility to asset markets and whose consumption is not limited by the labor income.

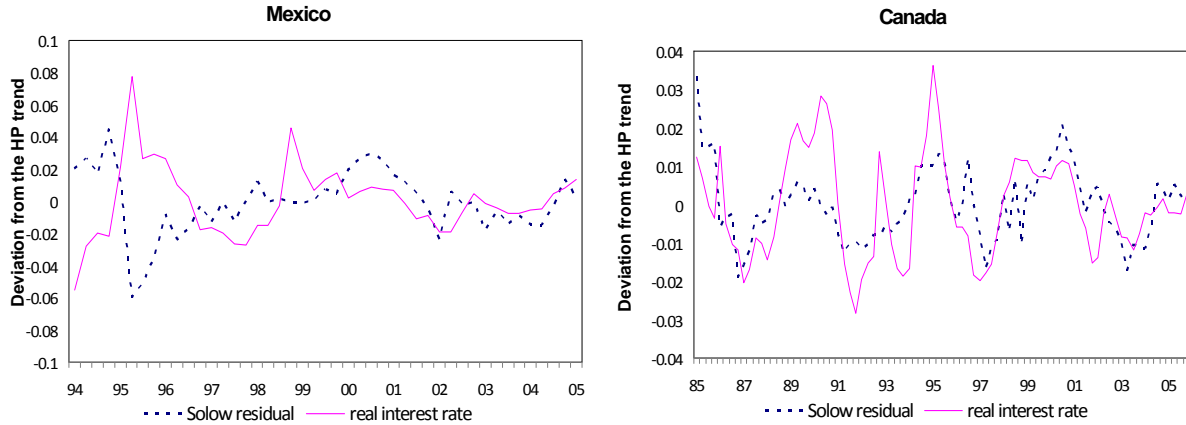
5.2 Estimation of shock processes

The model dynamics are driven by two exogenous stochastic disturbances that affect domestic total factor productivity and the real interest rate. Let the variable \hat{x}_t denote the log deviation of variable x_t from an HP filtered trend. They follow the first-order vector autoregressive process (VAR(1)) as below:

$$\begin{bmatrix} \hat{A}_t \\ \hat{r}_t^* \end{bmatrix} = \begin{bmatrix} \rho_{AA} & \rho_{Ar} \\ \rho_{rA} & \rho_{rr} \end{bmatrix} \begin{bmatrix} \hat{A}_{t-1} \\ \hat{r}_{t-1}^* \end{bmatrix} + \begin{bmatrix} \varepsilon_{A,t} \\ \varepsilon_{r,t} \end{bmatrix}$$

where ρ_{AA} and ρ_{rr} are the autocorrelation coefficients of productivity and real interest rate shocks respectively, and ρ_{Ar} and ρ_{rA} are the cross-correlation coefficients. $\varepsilon = [\varepsilon_{A,t}, \varepsilon_{r,t}]'$ is the shock process to the total factor productivity and the real interest rate. $E[\varepsilon_t] = 0_{2 \times 1}$, and $E[\varepsilon_t \varepsilon_s] = \begin{bmatrix} \sigma_{\varepsilon_A}^2 & \sigma_{\varepsilon_A, \varepsilon_r} \\ \sigma_{\varepsilon_r, \varepsilon_A} & \sigma_{\varepsilon_r}^2 \end{bmatrix}$, if $t = s$ and 0 otherwise.

Figure 11: Real Interest Rate and Calculated Solow Residual in Mexico and Canada.



Note: All the series are detrended using HP filter. The interest rate for Mexico is the real yield on dollar-denominated bonds of Mexico issued in the international financial market. The interest rate for Canada is the 90-day corporate commercial paper rate deflated by adaptive CPI inflation. See appendix for construction of Solow Residuals. Data source: OECD, EMBI.

To identify the parameters of the underlying stochastic processes for simulation, I construct quarterly “Solow residual” series by using the data from Mexico and Canada. It is generally problematic to estimate Solow residuals for developing economies, given the limited data availability and quality on capital formation, employment, working hours and the existence of adjustment costs. Nevertheless, I rely on two alternative series of labor inputs for both countries – employment and hours of working, and construct Solow residuals in the standard way (see Appendix A for details of calculations). Figure 11 displays the evolution of Solow residuals and the country interest rate spread or interest rate over the sample period.

Table 5 reports the estimated parameters on the VAR(1) process on Solow Residual and country interest rate from Mexico and Canada. All the series are HP-filtered. For both countries, the Solow Residuals generated by these two labor input series display similar persistence, volatility and correlation with the interest rate. The coefficients of the VAR(1) process for Mexico and Canada display similar characteristics, except that shocks in Canada seem to be more persistent than those in Mexico. Both innovations in Solow residuals and interest rates are around three times as volatile in Mexico than in Canada. Most importantly, they are negatively correlated in Mexico, while positive but not significantly correlated in Canada.

5.3 Computational experiments

The main interest of this section is to assess whether the differences in wage movements in emerging markets and developed economies can be attributed to financial factors, especially the observed relationship between interest rate shocks and productivity shocks. In order to do that, I analyze

Table 5: Parameter Estimates of the VAR(1) process of Interest Rate and Solow Residual

Independent Variables	Dependent Variables			
	Employment Based		Total Hours Based	
Mexico	\hat{A}_t	\hat{r}_t^*	\hat{A}_t	\hat{r}_t^*
\hat{A}_{t-1}	0.69(5.34)	0.19(2.06)	0.51(4.03)	0.26(1.87)
\hat{r}_{t-1}^*	-0.17(-1.48)	0.61(5.68)	-0.21(-1.89)	0.68(5.66)
Innovations	$\sigma_{\varepsilon_A} = 1.52\%$	$\sigma_{\varepsilon_r} = 1.70\%$	$\sigma_{\varepsilon_A} = 1.49\%$	$\sigma_{\varepsilon_r} = 1.61\%$
	$\rho(\varepsilon_A, \varepsilon_r) = -0.47$		$\rho(\varepsilon_A, \varepsilon_r) = -0.43$	
RMSE	0.0154	0.0171	0.015	0.0162
R^2	0.50	0.42	0.44	0.42
Canada	\hat{A}_t	\hat{r}_t^*	\hat{A}_t	\hat{r}_t^*
\hat{A}_{t-1}	0.83(14.32)	0.32(3.42)	0.58(7.26)	0.17(1.59)
\hat{r}_{t-1}^*	-0.05(-1.23)	0.70(10.04)	0.12(2.19)	0.73(9.65)
Innovations	$\sigma_{\varepsilon_A} = 0.46\%$, $\sigma_{\varepsilon_r} = 0.75\%$		$\sigma_{\varepsilon_A} = 0.59\%$	$\sigma_{\varepsilon_r} = 0.79\%$
	$\rho(\varepsilon_A, \varepsilon_r) = 0.07$		$\rho(\varepsilon_A, \varepsilon_r) = 0.16$	
RMSE	0.005	0.007	0.006	0.008
R^2	0.74	0.69	0.55	0.65

Note: t-statistics in the brackets

the statistical property of model economies using parameters reported in Table 4. The “developed small open economy” is represented by Canada, and the “emerging economy” is represented by Mexico. The second moments targeted for study are relative wage volatility (measured by the standard deviation of wage over the standard deviation of output) and the correlation coefficient between wage and output. The simulation is implemented using the DYNARE program, which uses a second-order Taylor approximation of the expectation functions (see Schmitt-Grohe and Uribe [2002]).

In particular, three main computational experiments are conducted here. First, I simulate the model driven by shock processes estimated to Mexico data and Canada data respectively and analyze the statistical properties. In order to see how the sign of the correlation coefficient of interest rates and productivity matters in the contract model, I simulate the model again using an artificial VAR(1) process of interest rate and productivity, which is identical to the estimated Mexico stochastic process but has the opposite sign of the correlation coefficient. I then compare the results with the previous ones. I also report the change in the statistical properties of wages with varying correlation coefficients of the interest rate and Solow residual. Finally, to study the impact of financial market development, I analyze the effect of increasing the debt adjustment parameter on targeted second moments.

Experiment 1 – contract model for Mexico and Canada, using different utility functions

Table 6 contains results for the model economy driven by shock processes estimated to Mexico data and Canada data respectively. Feeding different shock processes to the same model, wages

display different patterns. The wage is positively correlated with output when the underlying shock process is specified using Mexico data, and is negatively correlated with output when using Canada stochastic shock process. The wage is no longer highly correlated with the marginal product of labor. In addition, with a separable utility function or Cobb-Douglas utility function, the model generates more volatile wages relative to output in Mexico and more stable wages in Canada. However, in the case of separable utility function, the model does not generate enough wage volatility as in the data. This is due to the nature of risk-sharing labor contract, which helps to smooth out the wage fluctuation.

The model also underpredicts the procyclicality of labor input for Mexico (when the interest rate shock is countercyclical). The reason is that the income effect is relatively strong with a separable utility function. When the interest rate is countercyclical, a positive interest rate shock induces a drop in the consumption of the next period through the intertemporal substitution effect, amplifying the impact of a negative productivity shock on consumption. This explains why the model generates considerably larger volatility in consumption for Mexico than for Canada. Given by condition *C3*, labor does not demonstrate enough positive correlation with output.

Another major difference with the data is that the model with separable or Cobb-Douglas utility functions cannot generate a countercyclical trade balance as in the data. This corresponds to the comment by Correia et al [1995] – “the crucial aspect of their (the previous literature of small open economy) formulations that allows them to produce realistic volatilities is the adoption of the GHH (Greenwood, Hercowitz and Huffman [1988]) momentary utility function”. However, the GHH preference specification is not particularly useful when it comes to understanding the labor supply. By design, under GHH utility, the marginal rate of substitution between consumption and labor supply is independent of consumption decision. Therefore, it completely rules out the income effect and changes in labor input are not associated with fluctuations in wage. In other words, labor is fully responsive to the current shocks, as the current capital stock is predetermined from the last period (as shown in the the fifth and ninth columns, $\rho(n, y) \approx 1$). Models with the GHH utility function thereby generate quite stable, and always procyclical, wages, which is not consistent with the data in both emerging markets and developed economies.

Experiment 2 – the role of $\rho(\hat{A}, \hat{r}^*)$ and the working capital requirement From now on, I concentrate on using the separable utility function as examples. This experiment explores the role of the sign of correlation between the two underlying shock processes and the role of the working capital constraint by controlling for all the other factors. Table 7 compares the results from positively correlated productivity shocks and interest rate shocks with the results from negatively correlated shocks. Column (a) gives the results of the calibration when keeping everything else equal but flipping the sign of correlation of these two shocks from negative to positive. Instead of being procyclical, as shown in the third column, wage is now countercyclical and the wage volatility (as a ratio of output volatility) is reduced by about 50%. At the same time, consumption becomes less volatile and less procyclical and labor input more responsive.

In addition, Figure 12 shows that, other things equal, when the correlation of interest rate and productivity increases, the wage becomes more stable and less procyclical. In addition, as shown in Table 8, an increasing procyclicality of interest rate is also associated with more stable and less procyclical consumption, and more volatile and more procyclical labor. As explained earlier, procyclical interest rates help with consumption smoothing over time. Less response of consumption to exogenous shocks reduces the income effect, increases the sensitivity of labor input.

The last column of Table 7 shows the results when there is no working capital requirement, $\theta = 0$. Now, perfect risk sharing between workers and employers is achieved. Their consumptions display the same correlation with output, but workers' consumption is less volatile than the employers' as they are also more risk averse. However, in this case, wage volatility is less than output volatility and wage is also less procyclical since perfect risk sharing generates a more stable wage schedule.

Experiment 3 – flexibility of the external debt adjustment In the implicit contract framework, the existence of a labor contract is motivated by the fact that risk-averse workers cannot access asset markets to intertemporally smooth consumption as much as employers can. The optimal employment contract thus incorporates an insurance component so that workers can enjoy relatively more stable wage compensation than they do in the spot labor market. Therefore, workers' wage stability naturally depends on whether employers can effectively use the financial market to smooth consumption intertemporally. In other words, the level of financial market development would affect a risk-averse agent's optimal response to shocks. Recall that the interest rate faced by domestic firms is comprised of two parts: the exogenous world interest rate and the endogenous financial premium, which is an increasing function of the external debt position

$$r_t = r_t^* + \kappa[\exp(\frac{d_t}{y_t} - \bar{d}) - 1]$$

It is true that the underdevelopment of financial markets in emerging markets is already partly reflected in the countercyclical characteristics of the interest rate. But in this experiment I focus on role of the second term in the interest rate determination. Smith and Valderrama [2006] shows that financial frictions can generate a financial premium in real interest rates that is negatively correlated with output variation. In this paper, I abstract from the mechanism that links financial friction to the interest rate spread. The premise is that the decreased financial development level is associated with a higher unit debt adjustment cost, κ , or a more sensitive interest rate in response to the external debt position.

Assuming there is no exogenous interest rate disturbance, i.e. $\hat{r}_t^* = 0$, Figure 13 and Table 9 describe the effects of increasing κ on cyclical behavior of wages. When it is harder for employers to adjust their debt position in response to productivity shocks, consumption of both workers and employers become more volatile. It is less optimal to provide stable wage compensation, leading to more volatile and more procyclical wages. This implies that the less developed the financial market, the more volatile and procyclical the wage is, which corresponds to the empirical evidence in Figure 8.

6 Concluding Remarks

Understanding wage determination is crucial for monetary policy analysis. Wage formation is part of the inflation process and has important implications for optimal exchange rate policies. However, we know little about the cyclical wage behavior in emerging-market economies. In this paper, I document three facts that suggest cyclical wage movements in emerging markets follow quite different patterns from those in developed economies. Compared to developed countries, real wages are found to be much more volatile and more procyclical in emerging markets. The relative wage volatility decreases with the financial market development level. This paper then demonstrates that the observed difference in financial factors, especially the different relationship between the interest rate and output in emerging markets versus developed economies, can help to explain the differences. In particular, I show that in a small open economy model with a contractual arrangement between employers and more risk averse workers. A countercyclical interest rate in emerging markets makes wage payments more expensive in economic downturn and less so in booms, and generate a labor income effect through intertemporal substitution. This leads to weaker labor response and stronger wage response. The opposite is true for developed economies in which interest rates are procyclical. This is shown by several computational experiments conducted using shock processes estimated to the representative emerging market (Mexico) data and the benchmark developed country (Canada) data as driving forces.

My analysis emphasizes the role of countercyclical interest rate in wage fluctuation. Given the evidence shown in the paper, it is not only plausible but also relevant, although not exclusive. The paper does not rule out the important roles of other factors like labor market conditions and institutional factors. For example, research based on Euro area evidence shows that real wages in countries with a larger percentage of population covered by union contracts tend to display less procyclicality. Although one may speculate that the labor force is less unionized and trade density may be lower for poorer countries, it is not necessarily true in reality. Some Latin American countries and Korea actually have relatively high trade density. This direction is certainly interesting, but the data on labor market institutions is especially scarce for developing countries. In addition, the empirical evidence in the paper is based on aggregate level wage data and has its limitations, as mentioned in the paper. Future research using microeconomic evidence or individual level wage data would be certainly helpful in understanding the wage formation.

Table 6: Cyclical Moments for Mexico and Canada- Contract Labor Model

	Mexico				Canada			
	Data	Separable	CD	GHH	Data	Separable	CD	GHH
% Standard dev.								
y	2.38	2.38	2.38	3.73	1.31	1.16	1.31	1.31
r^*	2.19	2.19	2.19	2.19	1.34	1.30	1.30	1.30
A	2.15	2.14	2.14	2.14	0.96	0.83	0.83	0.83
% Standard dev. of x / % standard dev. of GDP								
w	1.91	1.03	1.67	0.57	0.60	0.50	0.43	0.23
n	0.48	0.38	0.65	0.51	0.64	0.37	0.47	0.42
l		0.39	0.62	0.62		0.37	0.47	0.40
h		0.38	0.68	0.44		0.36	0.47	0.43
c^E	1.66	0.77	1.15	0.93	0.70	0.41	0.48	0.63
c^W		0.81	1.47	1.13		0.31	0.47	0.56
i	3.69	4.12	0.91	3.69	2.71	4.84	4.05	3.89
tb/y	0.95	0.95	0.95	0.95	0.63	0.63	0.63	0.63
Correlation with GDP								
w	0.48	0.54	0.67	0.70	-0.28	-0.24	-0.11	0.57
n	0.45	0.21	0.26	0.98	0.81	0.79	0.92	1.00
l		0.21	0.53	0.94		0.79	0.93	0.99
h		0.21	0.34	0.99		0.79	0.91	1.00
c^E	0.69	0.72	0.60	0.85	0.82	0.60	0.82	0.89
c^W		0.78	0.69	0.87		0.57	0.79	0.86
i	0.91	0.63	0.55	0.49	0.69	0.79	0.76	0.15
tb/y	-0.73	0.04	0.24	-0.04	0.07	-0.10	-0.03	-0.16
r^*	-0.48	-0.25	-0.12	-0.45	0.61	0.46	0.48	0.47
A	0.91	0.95	0.90	0.92	0.89	0.99	0.98	0.94

Note: Theoretical moments are calculated from the contract labor model in section 2.3.2 using the parameters reported in Tables 4. The shock processes for Mexico and Canada are given in Table 5. See Appendix for a description of data construction. The capital adjustment cost parameter and the debt adjustment cost parameters are set so that the volatility trade balance as a ratio of GDP and volatility of output match the data. In details are: Mexico: Separable 1.25, 0.41; CD 9 0.32; GHH 8 0.09. Canada: Separable 0.00, 1.22; CD 0.12, 0.85; GHH 0.01, 1.03.

Table 7: Sign of Correlation of Solow Residual and Interest Rate and Working Capital Requirement

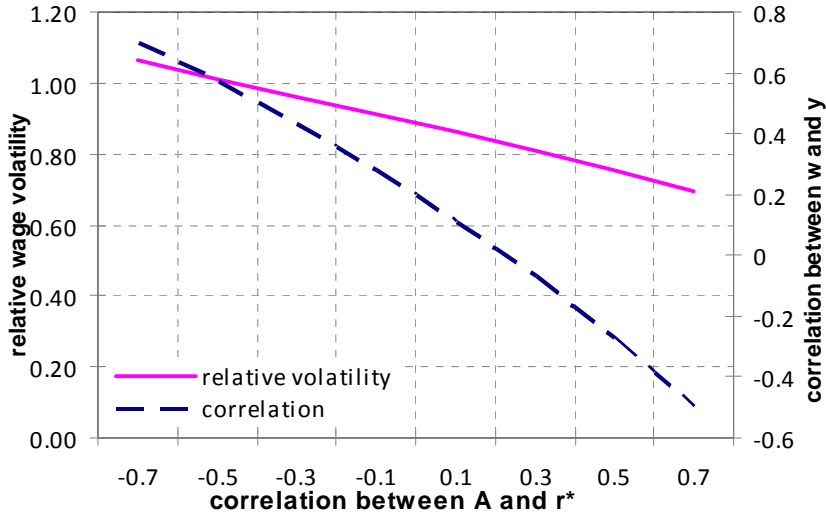
	Mexico	Simulated Moments		
	data	$\rho(a, r^*) = -0.47$	(a) $\rho(a, r^*) = 0.47$	(b) $\theta = 0$
% Standard dev.				
y	2.38	2.38	2.47	2.42
r^*	2.19	2.19	2.54	2.19
A	2.15	2.14	1.87	2.14
% standard dev. of x / % standard dev. of GDP				
w	1.87	1.03	0.77	0.78
n	0.46	0.38	0.46	0.37
l		0.39	0.47	0.37
h		0.38	0.46	0.37
c^E	1.66	0.77	0.46	0.72
c^W		0.81	0.48	0.54
i	3.69	4.12	2.45	3.95
tb/y	0.95	0.95	1.06	0.91
Correlation with GDP				
w	0.48	0.54	-0.24	0.37
n	0.47	0.21	0.75	0.28
h		0.21	0.75	0.28
l		0.21	0.75	0.28
c^E	0.69	0.72	0.35	0.72
c^W		0.78	0.35	0.72
i	0.91	0.63	0.89	0.63
tb/y	-0.73	0.04	0.69	0.17
r^*	-0.48	-0.25	0.37	-0.26
A	0.91	0.95	0.97	0.96

Note: Theoretical moments are calculated from the model that is based on additively separable utility, and parameters calibrated to Mexico. The only difference in calibration for the results presented in column 3 and 4 is the sign of correlation between Solow residual and real interest rate.

Table 8: Effects of Changes of Correlation between Solow Residual and Interest Rate Shock

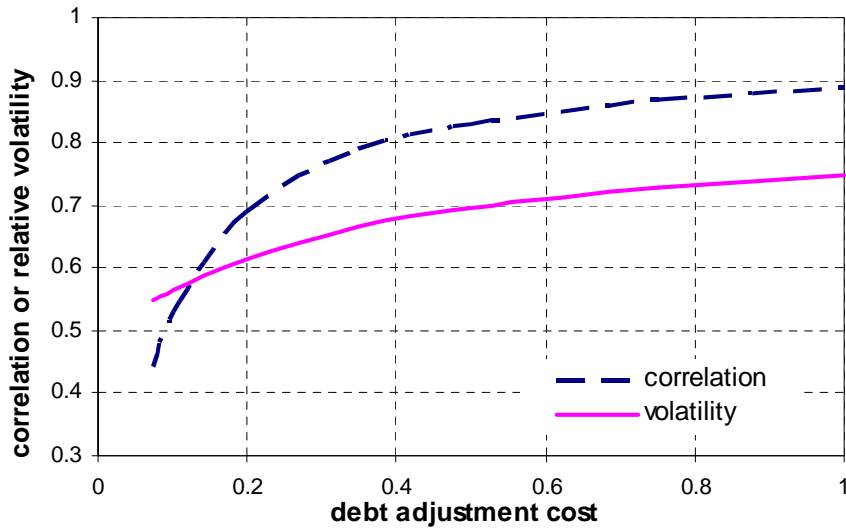
$\rho(a, r^*)$	$\sigma(y)$	$\frac{\sigma(w)}{\sigma(y)}$	$\frac{\sigma(n)}{\sigma(y)}$	$\frac{\sigma(c^E)}{\sigma(y)}$	$\frac{\sigma(c^W)}{\sigma(y)}$	$\rho(w, y)$	$\rho(n, y)$	$\rho(c^E, y)$	$\rho(c^W, y)$
-0.7	2.29	1.06	0.35	0.83	0.87	0.70	0.02	0.79	0.86
-0.5	2.32	1.01	0.37	0.78	0.82	0.57	0.18	0.73	0.79
-0.3	2.36	0.96	0.40	0.72	0.75	0.43	0.32	0.67	0.72
-0.1	2.4	0.91	0.41	0.66	0.69	0.28	0.45	0.59	0.63
0.1	2.43	0.86	0.44	0.60	0.63	0.11	0.57	0.52	0.55
0.3	2.46	0.81	0.45	0.53	0.55	-0.07	0.67	0.43	0.45
0.5	2.5	0.75	0.47	0.45	0.47	-0.27	0.77	0.33	0.33
0.7	2.53	0.69	0.48	0.37	0.38	-0.50	0.85	0.21	0.18

Figure 12: Cyclical Characters of Real Wage for Different Correlation between Productivity Shock and Interest Rate Shock



Note: Number on the left y-axis marks the standard deviation of real wage relative to standard deviation of output; right y-axis gives the correlation between real wage and output. These statistics are calculated based on separable utility function and Mexico parameters.

Figure 13: Cyclical Characters of Real Wage for Different Debt Adjustment Cost



Note: These statistics are calculated based on separable utility function and Mexico parameters.

Table 9: Effects of Debt Adjustment Costs

κ	$\sigma(y)$	$\frac{\sigma(w)}{\sigma(y)}$	$\frac{\sigma(n)}{\sigma(y)}$	$\frac{\sigma(c^E)}{\sigma(y)}$	$\frac{\sigma(c^W)}{\sigma(y)}$	$\rho(w, y)$	$\rho(n, y)$	$\rho(c^E, y)$	$\rho(c^W, y)$
0.075	2.46	0.55	0.26	0.55	0.48	0.44	0.57	0.84	0.80
0.1	2.43	0.56	0.23	0.57	0.50	0.53	0.52	0.86	0.82
0.2	2.36	0.61	0.19	0.62	0.57	0.69	0.35	0.91	0.87
0.35	2.31	0.67	0.16	0.66	0.61	0.79	0.19	0.94	0.90
0.5	2.29	0.65	0.13	0.55	0.48	0.83	0.07	0.95	0.92
0.75	2.27	0.73	0.13	0.70	0.67	0.87	-0.07	0.96	0.93

Note: Theoretical moments are calculated based on additively separable utility, and parameters are calibrated to Mexico (1994:1-2005:4) and are kept equal for each row, except for the debt adjustment cost parameter κ .

7 Appendix

A Data on Mexico and Canada

The data reported in Table 6 comes from OECD MEI Dataset. Consumption is measured by “private consumption”. Investment is “gross fixed capital formation”. Both are in constant prices. Employment is measured by two series, “civilian employment” and “total hours worked”. Trade balance is given by net exports, the difference between exports and imports.

The model is calibrated to the Mexico Data from 1994:1 to 2005:4 (as quarterly interest rate data is only available from 1994) and Canada data from 1985:1 to 2005:4. Solow residual is defined as $\ln A_t = \ln(y_t) - \alpha \ln(k_t) - (1 - \alpha) \ln n_t$. Capital share α is set to be 0.32 as in the calibration section. For Canada, employment is the “civilian employment” series. The total hours are calculated as the product of employment with working hours per worker, using “average weekly working hours in manufacturing” as a proxy. For Mexico, employment data is taken from Neumeyer and Perri [2004] extended to 2005:4 by using general employment series data from ILO periodical dataset. To calculate total hours worked, I divide total hours worked in manufacturing by total employment in manufacturing from OECD MEI to calculate the hours worked per employee in manufacturing and use it as a proxy for average hours per worker. The total hours worked is thus calculated from taking the product of total employment data from OECD and the derived average hours per worker.

For both countries, the capital stock is computed according to $k_t = (1 - \delta)k_{t-1} + i_t$, where $\delta = 2.5\%$. The initial capital stock data for year 1985 is based on Nehru and Dharehwar [1993], which derived capital stock series for 92 countries using a modified Harberger approach. The initial capital stock is then accumulated afterwards by using “gross fixed capital formation” series from OECD as investment.

B Relative income of Mexico

At the steady state, suppose entrepreneur and employee work about the same number of hours. Then the entrepreneur's wage rate relative to worker's is given by $\frac{m\eta}{1-\eta}$. With m being fixed, η can be calculated using Mexican household income distribution data. As in Gomme and Greenwood [1995], the income distribution is known to be approximately Pareto. The function of Pareto distribution is given by $F : [1, \infty] \rightarrow [0, 1]$, $F(x) = 1 - (\frac{x}{b})^{-a}$, where $x > b, a > 0$, x denotes the level of labor income and $F(x)$ is the fraction of the population whose wage rate is no more than x . Taking logarithm of both sides, we get a linear relationship between the fraction of individuals with income above x with the level x . That is

$$\ln(1 - F(x)) = a \ln b - a \ln x$$

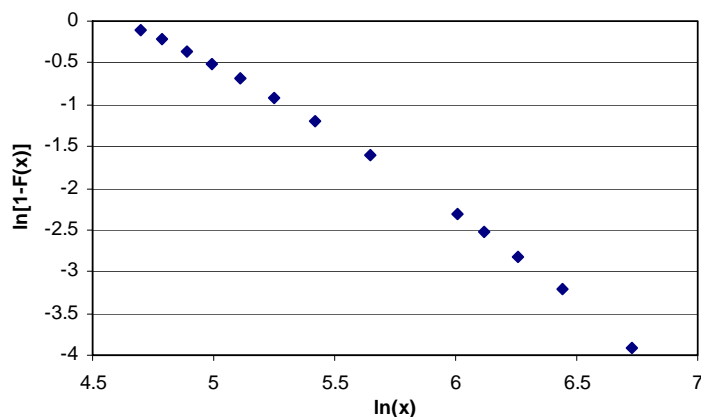
Using data from the lower tail of Mexico income distribution data (plotted in the figure below), we can estimate the parameters a and b . It is found that for Mexico data, $\ln(1 - F(x)) = 8.695 - 1.84 \ln x$, with $R^2 = 0.99$. The attribute of the Pareto distribution is that the average income of individuals in the top z percentage is given by

$$E[x|x \geq F^{-1}(1 - z)] = \frac{a}{a - 1} F^{-1}(1 - z)$$

Given $m = 1.5$, 40% of the total population are entrepreneurs. Suppose they are also those who earn income in the top 40%. Then the income ratio between entrepreneur and worker is given by

$$\frac{E[x|x \geq F^{-1}(0.6)]}{(1/0.6)E[x] - (0.4/0.6)E[x|x \geq F^{-1}(0.6)]}$$

Using the parameter a estimated from the linear regression, this ratio is estimated to be 1.46. Thus the top 40% earned 1.46 as much as the bottom 60% percent.



Relationship between $\ln(1-F(x))$ and $\ln(x)$ for Mexico, 1996.
Source: Lopez-Acevedo and Salinas [2000], world bank.

C Spot Labor Market Model

This section is to specify the spot labor market which is used to pin down the bargaining power parameter, μ , in the labor contract model. There are employers and workers with the same characteristics as in the contract labor market. The only difference is that employers and workers trade labor service in a Walrasian way. Each party takes wage as given in the equilibrium and maximizes their own utility separately by choosing optimal allocation variables. The model is specified as follows. After the state, s^t , is realized, workers sell time at the spot labor market and consume the labor income of the current period $c^W = wl$.

Given the wage, workers solve for optimal labor supply by

$$\begin{aligned} \max_l \quad & u(c_t^W, l_t) \\ \text{s.t.} \quad & c_t^W = w_t l_t \end{aligned}$$

The equilibrium wage would be equal to marginal rate of substitution as in standard model

$$w_t = -\frac{u_l(w_t l_t, l_t)}{u_c(w_t l_t, l_t)}$$

Given the initial condition (S_0, k_0, d_0) , and a sequence of wage schedules $\{w_t\}_{t=0}^{\infty}$, the entrepreneur's problem is to decide on labor input from the workers' l_t , capital investment k_{t+1} , and his own working effort h_t to maximize the present discounted value of life-time utility

$$\begin{aligned} \max_{c_{t+1}, h, k, l} \quad & \sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi(s^t | s_0) v(c_t^E, h_t) \\ c_t + i_t - d_t \leq \quad & F(k_t, m l_t, h_t; A_t) - m w_t l_t (1 + \theta r_{t-1}) - d_{t-1} (1 + r_{t-1}) \end{aligned}$$

In equilibrium, the entrepreneur's Euler equation for l_t equates the marginal cost of an extra unit of labor to the marginal product of labor. Combining the entrepreneur's and the workers' optimization conditions for labor, we obtain the following relationships,

$$w_t = \frac{F_l}{(1 + \theta r_{t-1})} = -\frac{u_l(w_t l_t, l_t)}{u_c(w_t l_t, l_t)}$$

The entrepreneur's own labor effort and capital investment decision have to satisfy

$$\begin{aligned} F_h(k_t, m l_t, h_t; A_t) &= -\frac{v_h(c_t^E, h_t)}{v_c(c_t^E, h_t)} \\ E_t \beta \frac{v_c(c_{t+1}^E, h_{t+1})}{v_c(c_t^E, h_t)} (F_{k,t+1} + (1 - \delta)) &= 1 \end{aligned}$$

The above first order conditions and market clearing condition determine the equilibrium.

D A Discussion of the Utility Functions

The choice of the utility function matters in two aspects: income effect and intertemporal substitution effect. In this section, I analyze these effects for three different preference specifications. The results comparing different utility functions are presented in Table 6.

GHH utility Correia et al [1995] point out that the Greenwood, Hercowitz and Huffman [1998] (*GHH*) momentary utility function is crucial for generating consumption volatility of the magnitude observed in the data. However, this class of utility function is not useful for understanding the labor market dynamics because it directly eliminates the income effect of productivity on labor input. More specifically, the efficiency condition under *GHH* preference is given by

$$MP_{l,t}^r = b\nu l_t^{\nu-1}$$

Without the income effect, employment is highly sensitive to labor productivity shock and interest rate induced shock on financial cost of hiring labor. Therefore, compared to other preference specifications, it generates higher labor input volatility and higher correlation between employment and output. The effects of productivity shocks and interest rate shocks on wage depend on the response of consumption to these shocks. Employers smooth consumption through international asset market, the linearized first-order condition on optimal debt generates

$$\hat{c}_{t+1}^E - \hat{c}_t^E = \frac{1}{\varsigma} \left(1 - \frac{\bar{w}}{\psi}\right) \frac{\bar{r}}{1 + \bar{r}} \hat{r}_t + \bar{w} (\hat{h}_{t+1} - \hat{h}_t)$$

where \bar{w} is the steady-state ratio between the employer's labor income, $F_h h$, and consumption, c^E . The combination of the two effects - intertemporal substitution effect (the first term) and the indirect effect derived from employment growth (the second term) generates a larger response of consumption than output (Neumeyer and Perri [2005]). Consequently, trade balance is more likely to display countercyclicality with a negative correlation between interest rate and productivity.

Moreover, workers' consumption is determined through risk sharing with employers

$$\hat{c}_t^W = \frac{\varsigma}{\sigma} \hat{c}_t^E - \frac{\kappa}{\sigma} \hat{r}_{t-1}$$

Wage is given by $\hat{w}_t = \hat{c}_t^W - \hat{l}_t$. Since employment fully responds to the exogenous shocks, the calibration of the model suggests workers' wage does not display enough volatility and always positive correlation with output under the presence of *GHH* preference.

Cobb-Douglas utility and additively separable utility Labor input in Cobb-Douglas utility function is determined by

$$MP_{l,t}^r = \frac{\nu}{1 - \nu} \frac{c_t^W}{1 - l_t} \tag{7}$$

and the Euler equation obtained from solving employers' optimal debt position yields

$$\hat{c}_{t+1}^E - \hat{c}_t^E = \frac{1}{1 - \psi(1 - \varsigma)} \frac{\bar{r}}{1 + \bar{r}} \hat{r}_t + \frac{(1 - \psi)(\varsigma - 1)}{1 - \psi(1 - \varsigma)} \frac{\bar{h}}{1 - \bar{h}} (\hat{h}_{t+1} - \hat{h}_t) \quad (8)$$

With separable utility function, the efficiency condition is

$$MP_{l,t}^r = b \frac{(c_t^W)^\sigma}{(1 - l_t)^v} \quad (9)$$

and Euler equation derived from employers' saving decisions implies

$$\hat{c}_{t+1}^E - \hat{c}_t^E = \frac{1}{\varsigma} \frac{\bar{r}}{1 + \bar{r}} \hat{r}_t \quad (10)$$

Comparing the two Euler equations (8) and (10), the equilibrium consumption based on CD preference is more volatile both because of the parameters $\frac{1}{1 - \psi(1 - \varsigma)} > \frac{1}{\varsigma}$ and the additional indirect effect from employment fluctuations. Both CD preference and consumption-leisure separable preference allow income effect on employment, as implied in (7) and (9), making employment less responsive. Therefore, the change in workers' consumption is reflected in a larger change in their wage and wage rate is more responsive. Moreover, for a given amount of consumption volatility, the separable utility function has a larger income effect ($\sigma > 1$). Because this large income effect offset the direct effect of productivity shocks, labor does not respond to output very much (correlation of labor and output is 0.21 in Table 6).

E Data Sources

	Period	Quarterly					Annual	
		Real GDP	Interest Rate	Wage (all)	Wage (manu)	CPI	Period	Wage (manu)
Emerging Economies								
Argentina	1990.1-1996.4	NP	EMBI+	-	IFS	EIU	1987-2001	UNIDO
Brazil	1992.1-2005.4	OECD	EMBI+	OECD	-	EIU	1984-1997	ILO
Chile	1985.1-2005.4	IFS	EIU	ILO	ILO	IFS	1975-2000	UNIDO
Czech Rep.	1995.1-2005.4	IFS	OECD	OECD	OECD	OECD	1993-2003	IFS
Ecuador	1993.1-2005.1	IFS	EMBI+	EIU	-	EIU	1975-1994	ILO
Hong Kong	1993.1-2005.4	IFS	EIU	EIU	ILO	EIU	1975-2004	BLS
Israel	1989.1-2005.4	IFS	EIU	IFS	ILO	IFS	1980-2004	BLS
Korea	1989.1-2005.4	OECD	EMBI G	OECD	OECD	OECD	1975-2004	BLS
Mexico	1985.1-2005.4	OECD	EMBI+	-	OECD	EIU	1975-2004	BLS
Philippines	2001.1-2005.1	IFS	EMBI+	IFS	-	EIU	1975-1997	UNIDO
Russia	1993.1-2005.4	OECD	EMBI+	OECD	-	OECD	1993-1998	UNIDO
Singapore	1993.1-2005.4	IFS	EIU	EIU	ILO	EIU	1975-2004	BLS
Slovak Rep.	1991.1-2005.4	OECD	OECD	OECD	OECD	OECD	1993-2003	IFS
Taiwan	1993.1-2005.4	OECD	EIU	EIU	ILO	EIU	1975-2004	BLS
Turkey	1993.1-2005.4	OECD	EMBI G	-	OECD	EIU	1993-2001	ILO
Developed Economies								
Australia	1985.1-2005.4	OECD	OECD	OECD	OECD	IFS	1975-2004	BLS
Austria	1985.1-2005.4	OECD	OECD	OECD	OECD	IFS	1975-2004	BLS
Belgium	1985.1-2005.4	OECD	OECD	IFS	OECD	IFS	1975-2004	BLS
Canada	1985.1-2005.4	OECD	OECD	-	OECD	IFS	1975-2004	BLS
Denmark	1985.1-2005.4	OECD	OECD	IFS	OECD	IFS	1975-2004	BLS
France	1985.1-2005.4	OECD	OECD	OECD	OECD	IFS	1975-2004	BLS
Germany	1985.1-2005.4	OECD	OECD	IFS	OECD	IFS	1975-2004	BLS
Italy	1985.1-2005.4	OECD	OECD	IFS	OECD	IFS	1975-2004	BLS
Japan	1985.1-2005.4	OECD	OECD	OECD	OECD	IFS	1975-2004	BLS
Netherlands	1985.1-2005.4	OECD	OECD	IFS	OECD	IFS	1975-2004	BLS
New Zealand	1987.1-2005.4	OECD	OECD	OECD	OECD	IFS	1975-2004	BLS
Norway	1985.1-2005.4	OECD	OECD	-	OECD	IFS	1975-2004	BLS
Sweden	1985.1-2005.4	OECD	OECD	OECD	OECD	IFS	1975-2004	BLS
U.K.	1985.1-2005.4	OECD	OECD	OECD	OECD	IFS	1975-2004	BLS
U.S.A.	1985.1-2005.4	OECD	OECD	-	OECD	IFS	1975-2004	BLS

Notes: NP stands for Neumeyer and Perri [2005]. EMBI + stands for JP Morgan Emerging Market Bond Index plus dataset; EMBI G stands for JP Morgan Emerging Market Bond Index Global Dataset. EMBI Global data base allows for less liquid assets than the EMBI+ dataset.

References

- [1] Abraham, Katharine and John Haltiwanger (1995), "Real Wages and the Business Cycle", *Journal of Economic Literature*, Vol. 33, No. 3, pp. 1215-1264.
- [2] Agenor, Pierre-Richard, John McDermott, and Eswar S. Prasad (2000), "Macroeconomic Fluctuations in Developing Countries: Some Stylized Facts", *The World Bank Economic Review*, Vol. 14, No. 2, pp 251-285.
- [3] Aguiar, Mark and Gita Gopinath (2004), "Emerging Market Business Cycles: The Cycle is the Trend", *NBER Working Paper*, No. 10734.
- [4] Azariadis, Costas (1975), "Implicit Contracts and Underemployment Equilibria", *Journal of Political Economy*, Vol. 83, No. 6, pp 1183-1202.
- [5] Beaudry, Paul and John DiNardo (1991), "The Effect of Implicit Contracts on the Movement of Wages over the Business Cycle: Evidence from Micro data", *Journal of Political Economy*, Vol. 99, no. 4, pp 665-688.
- [6] Baily, Martin Neil (1974), "Wages and Employment under Uncertain Demand", *Review of Economics Studies*, No. 41, pp.37-50.
- [7] Beck, Thorsten, Asli Demirgüç-Kunt and Ross Levine (2000), "A New Database on Financial Development and Structure", *World Bank Economic Review*, No.14, pp 597-605.
- [8] Bils, Mark J. (1985), "Real Wages over the Business Cycle: Evidence from Panel Data", *Journal of Political Economy*, Vol. 93, No. 4, pp. 666-689.
- [9] Blundell, Richard, and Thomas MaCurdy (1999), "Labor Supply: A Review of Alternative Approaches," *Handbook of Labor Economics*, ed. by Orley Ashenfelter, and David Card, Vol. 3, pp. 1559-1695, Elsevier Science, Amsterdam.
- [10] Boldrin, Michele and Michael Horvath (1995), "Labor Contracts and Business Cycles", *Journal of Political Economy*, Vol. 103, no.5, pp 972-1004.
- [11] Caballero, Rodrigo (2000), "Macroeconomic Volatility in Latin America: A View and Three Case Studies", *NBER Working Paper* No. 7782.
- [12] Campbell, John and Mankiw Gregory (1989), "Consumption, Income, and Interest Rates: reinterpreting the Time Series Evidence", *NBER Macroeconomics Annual 1989*, edited by Olivier Blanchard and Stanley Fischer, MIT Press, Cambridge.
- [13] Chari, V.V., Patrick Kehoe and Ellen McGrattan (2005), "Sudden Stops and Output Drops", Federal Reserve Bank of Minneapolis, Staff Report 353.

- [14] Chinn, Menzie and Hiro Ito (2005), "Capital Account Liberalization, Institutions and Financial Development: Cross Country Evidence", *NBER working paper*, No. 8967.
- [15] Christiano, Lawrence and Martin Eichenbaum (1995), "Liquidity Effects, Monetary Policy, and the Business Cycle", *Journal of Money Credit and Banking*, Vol.27, No.4, pp 1113-1136.
- [16] Compton, Ryan and Jose Ricardo de Costa e Silva (2006), "Capital Flows and Destabilizing Policy in Latin America", Proceedings of the 34th Brazilian Economics Meeting 12, ANPEC - Brazilian Association of Graduate Programs in Economics
- [17] Correia, Isabel, Joao Neves and Sergio Rebelo (1995), "Business Cycles in a Small Open Economy", *European Economic Review*, Vol. 39, pp 1089-1113.
- [18] Danthine, Jean-Pierre and John Donaldson (1992), "Risk Sharing in the Business Cycle", *European Economic Review*, no. 36, pp. 469-75
- [19] Erb, Claude B., Campbell R. Harvey and Tadas E. Viskanta (1996), "Political Risk, Financial Risk and Economic Risk", *Financial Analysts Journal*, Vol. 52, pp 29-46.
- [20] Golin, Douglas (2002), "Getting Income Shares Right", *Journal of Political Economy*, Vol. 110, No. 2, pp 458-474.
- [21] Gomme, Paul and Jeremy Greenwood (1995), "On the Cyclical Allocation of Risk", *Journal of Economic Dynamics and Control*, Vol. 19, pp 91-124.
- [22] Hall, Robert (2005), "Employment Fluctuations with Equilibrium Wage Stickiness", *American Economic Review*, Vol. 95, No. 1, pp 50-65.
- [23] King, Robert and Sergio Rebelo (1999), "Resuscitating Real Business Cycles", in: J. B. Taylor and M. Woodford (ed.), *Handbook of Macroeconomics*, Ed. 1, Vol. 1, pp. 927-1007, Elsevier, Amsterdam.
- [24] Kaminsky, Graciela, Carmen Reinhart and Carlos Végh (2004), "When It Rains, It Pours: Pro-cyclical Capital Flows and Macroeconomic Policies", *NBER working paper series* 10780.
- [25] Lane, Philip and Gian Maria Milesi-Ferretti, "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970-2004", *IMF Working Paper* 06/69.
- [26] Mankiw, N. Gregory and Stephen P. Zeldes (1991), "The Consumption of Stockholders and Nonstockholders", *Journal of Financial Economics*, No. 29, pp. 97-112.
- [27] Mendoza, Enrique (1991), "Real Business Cycles in A Small Open Economy", *American Economic Review*, Vol. 81, No. 4, pp 797-818.
- [28] Mendoza, Enrique (2006), "Endogenous Sudden Stops in a Business Cycle Model with Collateral Constraints: A Fisherian Deflation of Tobin's q", mimeo, University of Maryland.

- [29] Merz, Monika (1995), “Search in the Labor Market and the Real Business Cycle”, *Journal of Monetary Economics*, Vol. 36, pp 269-300.
- [30] Nehru, Vikram, and Ashok Dhareshwar (1993), “A New Database on Physical Capital Stock: Sources, Methodology and Result”, *Revista de Análisis Económico*, No. 8(1), pp 37–59.
- [31] Neumeyer, Pablo and Fabrizio Perri (2005), “Business Cycles in Emerging Economies: the Role of Interest Rates”, *Journal of Monetary Economics*, Vol. 52, pp 345-380.
- [32] Oviedo, P. Marcelo (2005), “World Interest Rate, Business Cycles, and Financial Intermediation in Small Open Economies”, working paper, Iowa State University.
- [33] Pencavel, John (1986), “Labor Supply of Men: A Survey” in Orley Ashenfelter and Richard Layard, eds., *Handbook of Labor Economics*, Vol. 1, Amsterdam: North-Holland, 1986, pp 3-102.
- [34] Pistaferri, Luigi (2003), “Anticipated and Unanticipated Wage Changes, Wage Risk, and Intertemporal Labor Supply”, *Journal of Labor Economics*, Vol. 21, No. 3, pp. 729-754.
- [35] Rogerson, Richard, Robert Shimer and Randall Wright (2005), “Search Theoretic Models of the labor Market”, *Journal of Economic Literature*, Vol. 43, No. 4, pp. 959-988.
- [36] Rosen, Sherwin (1985), “Implicit Contracts: A Survey”, *Journal of Economic Literature*, Vol. 23, No. 3, pp 1144-1175.
- [37] Sigouin, Christian (2000), “Self-enforcing Employment Contracts and Business Cycle Fluctuations”, *CREFE working paper* No. 127
- [38] Schmitt-Grohe, Stephanie and Martin Uribe (2003), “Closing Small Open Economy Models”, *Journal of International Economics*, Vol. 61, pp 163-185.
- [39] Schmitt-Grohe, Stephanie and Martin Uribe (2002), “Solving Dynamic General Equilibrium Models Using a Second-Order Approximation to the Policy Function”, mimeo, Rutgers University.
- [40] Smith, Katherine and Diego Valderrama (2006), “The Composition of Capital Flows When Emerging Market Firms Face Financing Constraints”, Stanford Institute for Theoretical Economics (SITE) discussion paper.
- [41] Uribe, Martin and Vivian Z. Yue (2006), “Country Spreads and Emerging Countries: Who Drives Whom?”, *Journal of International Economics*, Vol. 69, pp 6-36.