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Cyclical wage movements in emerging markets compared to developed economies: The role of interest rates

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A B S T R A C T

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, and (ii) real wage volatility (relative to output volatility) is about twice as high in emerging markets compared with developed economies. We then present a small open economy model with productivity shocks and countercyclical interest rates. The model incorporates a working capital requirement and the Jaimovich and Rebelo (2009) preference that allows for flexible parameterization of the strength of income effects on labor supply. The model can account for the high volatility of wage and consumption relative to output and countercyclical trade balances that characterize emerging-market economies. During economic downturns, rising interest rates in emerging markets induce relatively large income effects on labor supply, so households would not reduce their labor input as much even though wages drop significantly.

1. Introduction

Real wage rigidity has been one of the essential characteristics of many modern macroeconomic models, especially those used for evaluating macroeconomic policy. 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.[2] In contrast to developed economies, emerging economies have lower but faster growing per capita income, higher aggregate uncertainty, less developed financial sectors and countercyclical interest rates. Given these economic differences and the importance of wage stickiness in monetary policy evaluation, a natural question to ask is whether emerging markets also have rigid wages.

This paper has two objectives. The first objective is to systematically document the cyclical behavior of real wages in a sample of emerging economies and contrast it with the wage behavior in developed economies using aggregate data. The second is to study whether the well-documented observations of countercyclical interest rates in emerging markets can help to quantitatively explain the different wage behavior in emerging markets relative to the advanced economies in a small open economy model, as well as generating other robust and distinguishing features of business cycles in emerging markets

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[1] I received insightful comments from Paul Evans, Robert Hall, Peter Henry, Nir Jaimovich, Pete Klenow, Benjamine Malin, Ronald McKinnon, John Taylor and seminar participants at Bank of Canada, Columbia, Johns Hopkins, London Business School, Ohio State University, Stanford, St. Louis Fed, UC Santa Cruz, Wisconsin–Madison, Midwest Macro 2008 and Society of Economic Dynamics 2008.

[2] For example, the literature discussing the optimal exchange rate regime often follows Mundell (1961) by assuming sticky wages for non-advanced economies as well. As illustrated in Mundell (1961), under the conditions of sticky wages and limited labor mobility, countries with a fixed exchange rate would find it harder to adjust to demand shocks than countries that can revalue their currencies more freely. However, if the real wage is relatively flexible, the optimal solution can be quite different.

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such as volatile consumption relative to output and the countercyclical trade-balance-to-GDP ratio (Neumeyer and Perri, 2005; Aguiar and Gopinath, 2007; Garcia-Cicco et al., 2006).

Using a sample of fifteen emerging markets and fifteen developed economies for the period 1985Q1 to 2005Q4, we document novel facts suggesting that, at the aggregate level, rigid real wages seem to be confined to high income economies. In contrast to developed economies, where real wages are on average 30 percent less volatile than output, they are on average 70 percent more volatile than output in emerging markets. The ratio of average real wage volatility to output volatility in emerging economies is about twice that of 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 these countries, while real wages display no systematic cyclical pattern in developed countries. Existing data also show that relative to developed economies, the volatility of labor input relative to output and the correlation between labor and output are lower in emerging markets, which suggests room for a stronger income effect on labor supply over the business cycle.

Meanwhile, another striking feature of emerging-market economies documented recently is that during economic expansions real interest rates appear to be low, while periods of economic stresses are often accompanied by high real interest rates that they face in international financial markets. Neumeyer and Perri (2005) report an average cyclical correlation between the real interest rates on external bonds and output of −0.55 in five emerging economies, and Uribe and Yue (2006) find it to be −0.42 in their sample of seven emerging economies.[3] Moreover, the swings in these interest rates are frequent and dramatic. 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.

To understand how different interest rate fluctuations account for the contrasting wage movements, following Mendoza (1991) we construct and calibrate a small open economy business cycle model (RBC-SOE) that incorporates two departures from the basic models. First, similar to Neumeyer and Perri (2005), firms have to finance their production input (i.e. labor) before sales are cashed out due to the lack of synchronization between receipts and payments (e.g. "pay-as-you-go" wage schedules, trade credit). Therefore, interest expenses directly add to labor costs.

In a small open economy, in which not only productivity shocks but also interest rate shocks are driving the business cycle, interest rates rise when output falls because of the increasing default risk. The increase in interest rates acts as a negative labor demand shock, amplifies productivity shocks, and at the same time depresses equilibrium consumption through the intertemporal substitution effect, as workers would like to save more by working harder. Consequently, workers do not cut back their labor supply by much in order to meet their consumption needs even though labor productivity declines and the wage falls significantly. As the labor input is not very responsive and the interest rate introduces a direct wedge between wage and labor productivity via the working capital channel, the wage becomes more responsive to shocks, displaying high volatility and large positive correlation with output.

However, the technical difficulty is to generate predictions that are not only consistent with labor market phenomena but also with other previously documented evidence, such as countercyclical trade balances. In order to account for high consumption volatility and countercyclical trade balances, a common practice in the RBC-SOE literature is to consider preferences in which the labor supply is independent of consumption (i.e. Greenwood et al., 1988, type of preferences). With this type of preferences, the income effect is absent and volatile labor input is translated into volatile output. As shown in our calibration, however, even with working capital requirements, wage volatility is less than output volatility.

Therefore, our second modification of the basic RBC-SOE models is to consider a preference specification that allows for flexible parameterization of income effects. We use the utility function proposed by Jaimovich and Rebelo (2009), in which the disutility of work depends on consumption habit in addition to current consumption and leisure. In response to interest rate shocks, the value of current consumption relative to consumption habit drops significantly, implying a decline in the disutility of work. The strength of this income effect on labor supply depends on the parameter that governs the sluggishness of the formation of the consumption stock. Since the current interest rate affects the financial cost of hiring labor only in the next period, the labor input initially increases, followed by a large decrease in the subsequent period when the impact of a higher interest rate on the financial cost of hiring labor is materialized. This leads to an initial decline in equilibrium wage and a larger decline in the next period. In both periods, an interest rate shock causes a larger decline in the wage than in output, which is the opposite of the reaction in response to a productivity shock. While the income effect on labor supply is preserved with this preference, the choice of the parameter of consumption stock formation ensures that the income effect does not limit output volatility too much or lead to unrealistic cyclicality of trade balances.

We then use the model to quantitatively assess the role of interest rates in accounting for the aforementioned business cycle characteristics in emerging markets. We use data from a representative emerging market, Mexico, to provide guidance on the parameters of the VAR(1) stochastic process of the productivity shocks and interest rate shocks. Following Neumeyer and Perri (2005), we also consider an alternative shock structure in which interest rate shocks are induced by the fundamental shocks to the economy. We find that (i) the baseline model generates procyclical and more volatile wages for

[3] 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.

the representative emerging economies; (ii) the aforementioned cyclical wage, consumption and trade balance behavior are mostly driven by countercyclical interest rate shocks; (ii) similar to Neumeyer and Perri (2005), induced interest rate shocks account for most regularities better.

The main discrepancy between our model predictions and empirical observations is that the cyclical correlation between wage and output tends to be too large in the model economy. With the Walrasian spot labor market, the wage is tightly connected with the marginal product of labor (adjusted by financial cost of employment when there is working capital requirement). When introducing a quadratic labor adjustment cost, the cyclical correlation between wage and GDP is reduced but it is achieved at the expense of lowering output volatility, as this type of labor friction typically slows down the adjustment of the labor input.

Our model builds mostly on a series of work that emphasizes the role of countercyclical interest rates in driving the business cycle dynamics in emerging markets (e.g. Neumeyer and Perri, 2005; Uribe and Yue, 2006; Aguiar and Gopinath, 2006, and Oviedo, 2005), which belongs to a class of empirical and quantitative work on RBC-SOE (e.g. Carcia-Cicco et al., 2006; Mendoza and Yue, 2008; Aguiar and Gopinath, 2007; Correia et al., 1995). However, little work has been done focusing on labor market behavior in emerging-market business cycle models. Recently, Boz et al. (2009) investigate the interaction between interest rate shocks and Mortensen–Pissarides type of labor market frictions and the implication of this interaction on labor market dynamics in emerging economies. They find even without the working capital channel, the rise in interest rates induces large drops in consumption and the negotiated wage during economic downturns because the prospect of being laid off and searching for jobs is gloomier with the presence of labor market frictions, and households would like to save more by working hard.

The empirical findings of volatile and procyclical wages in emerging markets are important and relevant for policy related studies and for understanding risk sharing in these countries. From the welfare prospective of individuals, if wages are flexible, then employers may use wages as a natural shock absorber when uncertainty is high and financial markets are less developed. On the other hand, flexible wages may also imply faster adjustment to external shocks. This point is related to the literature that focuses on the role of labor markets in understanding recoveries from financial crises and business cycles (e.g. Bergoeing et al., 2002 and Kehoe and Ruhl, 2007). More important, wage formation is part of the inflation process and understanding wage determination is crucial for monetary policy analysis. Policy implications can be significantly different without the assumption of wage stickiness. However, to better understand and answer these questions, we still need better microeconomic evidence or individual wage data.

The remainder of the paper is organized as follows. Section 2 discusses the data and empirical observations. Section 3 presents an RBC-SOE model. In Section 4, we parameterize the models using data from Mexico, and simulate the model and investigate the cyclical properties. Section 5 concludes.

2. Empirical evidence: wages, labor inputs and interest rates

This section presents some features of wage and interest rate movements and their relationship with the business cycles from 1985 to 2005 in 15 small open emerging economies — Argentina, Brazil, Chile, the Czech Republic, Ecuador, Hong Kong, Israel, Korea, Mexico, Philippines, Russia, Singapore, the Slovak Republic, Taiwan and Turkey. To compare the characteristics of emerging economies with developed countries, we 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 economies.[4] Data availability limits the choice of countries and time periods. For some emerging countries, wage and output data are only available and may be more reliable beginning in the early 1990s. Therefore, data for emerging economies are included as and when they become available. All series are in logs (except for the real interest rate), deseasonalized if necessary, and filtered using the Hodrick–Prescott (HP) filter.

2.1. Data description

We use the real gross domestic product (GDP) as a business cycle indicator. Constructing the real wage (i.e. nominal wage deflated by the consumer price index[5]) for emerging markets is difficult. For most countries, there are two types of nominal wage indicators in the data: hourly earnings/wage for all economic activities and hourly earnings/wage for the manufacturing sector.[6,7] For a few countries, there is no direct hourly wage data from any source or no working hours

[4] There 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 the World Economic Outlook categorizes them as "advanced economies" and J.P. Morgan and the United Nations consider them as "emerging economies". In this paper, only pre-1994 OECD countries are considered as developed economies, but wage behavior in Hong Kong, Taiwan and Singapore is similar to that in the other advanced economies.

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

[6] Hourly earnings often include overtime pay, incentive pay, bonuses, etc. Therefore, it is somewhat broader than that of hourly wage. The difference is ignored here, as they are close at the quarterly frequency.

[7] We 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.

data to construct the hourly wage. In these cases, nominal wages refer to monthly earnings or daily earnings. The main source of the quarterly nominal wage data is the Organization for Economic Co-operation and Development (OECD) Main Economic Indicators dataset, while the wage data for some 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 Appendix C 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 the annual estimates, we also report the results generated by annual manufacturing wage data (1975–2004) in Appendix B.

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 quarters) is subtracted from the 3-month nominal interest rates to obtain real interest rates. For most emerging countries, real interest rates are the sum of the EMBI+ spread index or the EMBI Global index[8] and the world real interest rate (the U.S. real interest rate on 3-month Treasury bonds). Of the fifteen emerging economies in the sample, eight are included in either the J.P. Morgan EMBI+ database or the EMBI Global database: Argentina, Brazil, Ecuador, Mexico, Korea, Philippines, Russia and Turkey.

One concern is about the relevance of the measured real interest rate for private firms that may not issue international bonds directly. Mendoza and Yue (2008) construct a measure of firm-level effective interest rates using the ratio of a firm's debt service to its total debt obligations. They find that the firm-level interest rates are closely related to the country interest rates (e.g. the median correlation between the two is 0.7 for 18 emerging markets).

2.2. Observations

Figs. 1 and 2 depict the cyclical relationship between real GDP and real wages for six representative emerging countries and six small open developed economies.[9] Figs. 3 and 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. Also, real wages are in general more volatile compare to real output in emerging market, but the opposite is true in developed economies. Real interest rates display striking contrast as well: they are more volatile and countercyclical in emerging-market economies, but procyclical or acyclical in developed countries.[10]

The graphical evidence is confirmed by statistics on cyclical real wage movements across countries presented in Table 1. At business cycle frequencies, real wage volatility is about 30–70% more volatile than output in emerging markets, but 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 Poor's (2000) and the International Finance Corporation. Wages in Chile are less volatile than output because in early 1980s 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 more volatile than in 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 cyclicality, wages are found to be mostly procyclical in emerging markets but acyclical for developed countries. The contemporaneous correlation coefficients exceed 0.40 in Chile, the Czech Republic, Ecuador, Korea, Mexico, the Slovak Republic and Taiwan. This is consistent with 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. The survey by Abraham and Haltiwanger (1995) concludes that available empirical evidence of real wage cyclicality is not conclusive about the direction and the degree of cyclical wage movement in responding to business cycle

[8] The Emerging Markets Bond Index (EMBI) 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 the somewhat strict EMBI+ limits on secondary market trading liquidity.

[9] The six representative emerging markets are the ones that have EMBI constructed real interest rates. The six developed economies are selected to represent small open economies from different geographic areas.

[10] The evidence is consistent with Kaminsky et al. (2004), where they study the domestic real interest rates instead of international interest rates. They find that interest rates are countercyclical and monetary policies are procyclical in the 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 several explanations (see Calvo and Reinhart, 2002, and Kaminsky et al., 2004, for details). 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, etc.

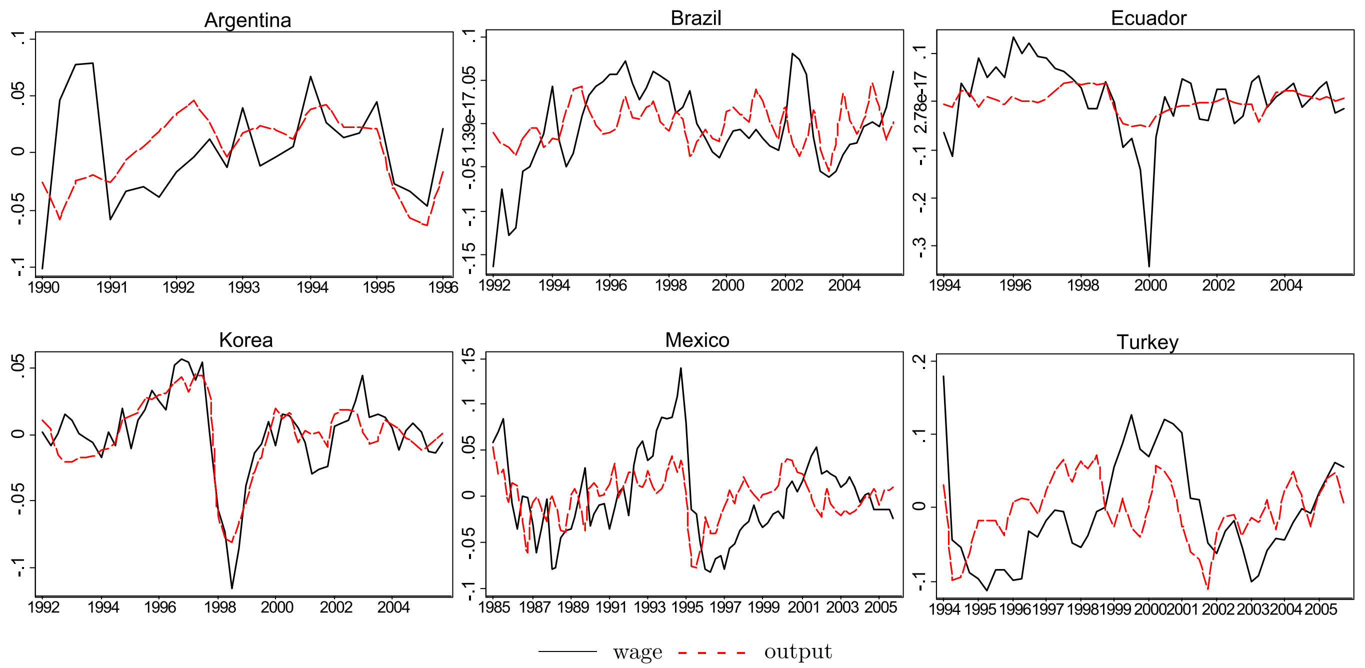

Fig. 1. Output and wages in emerging markets.

Note: The time series in the figures are percentage deviations from the 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 the Hodrick–Prescott filter with a smoothing parameter of 1600. Data sources: IFS, OECD, EIU.

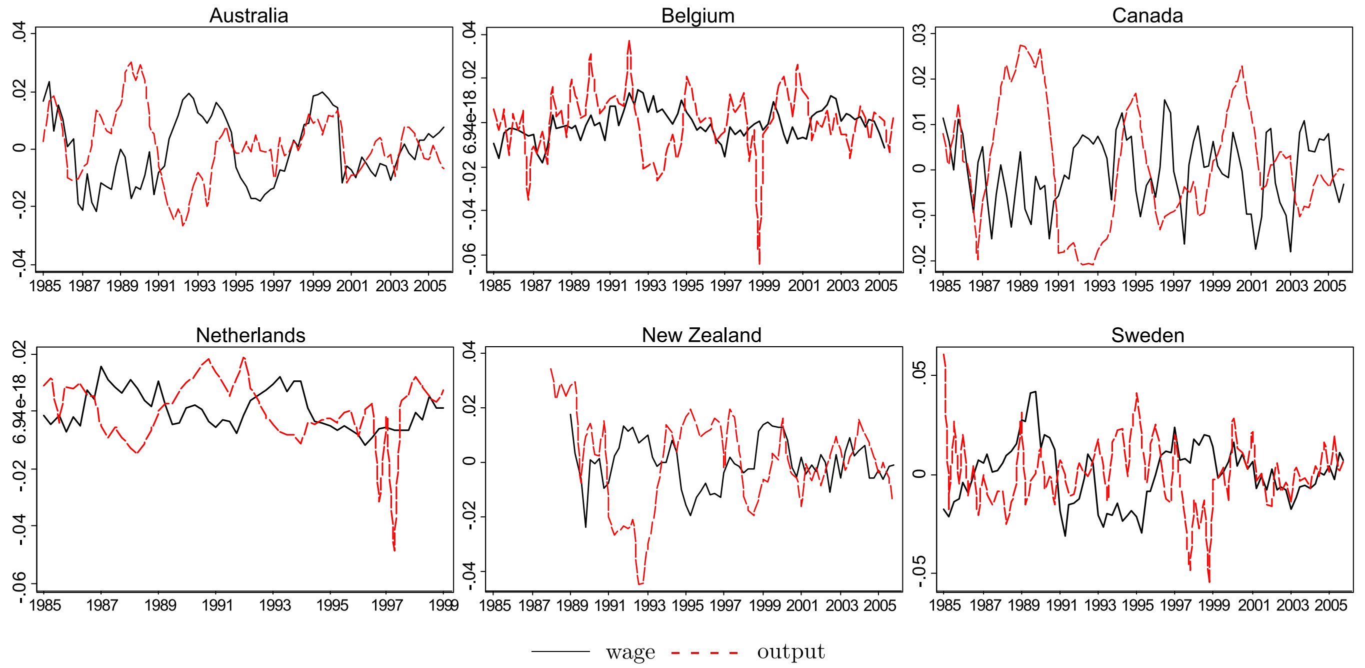

Fig. 2. Output and wages in developed economies.

Note: The 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 the Hodrick–Prescott filter with a smoothing parameter of 1600. Data sources: IFS, OECD.

fluctuations. The t-statistics reported in the bottom suggests that statistically there are significant differences in the relative wage volatility and wage procyclicality between the two country groups.

In addition, as country interest rates are strongly countercyclical and real wages are strongly procyclical in emerging markets, the contemporaneous correlation between these two variables tends to be negative. However, this correlation is only slightly negative in developed economies, because wages do not fluctuate too much with business cycles and interest rates are often acyclical.

Fig. 5 presents the pattern of cross-correlation between wages from period $t-4$ to $t+4$ and output at period t for the sample of emerging economies and small open developed countries and Fig. 6 describes the cyclical behavior of real interest

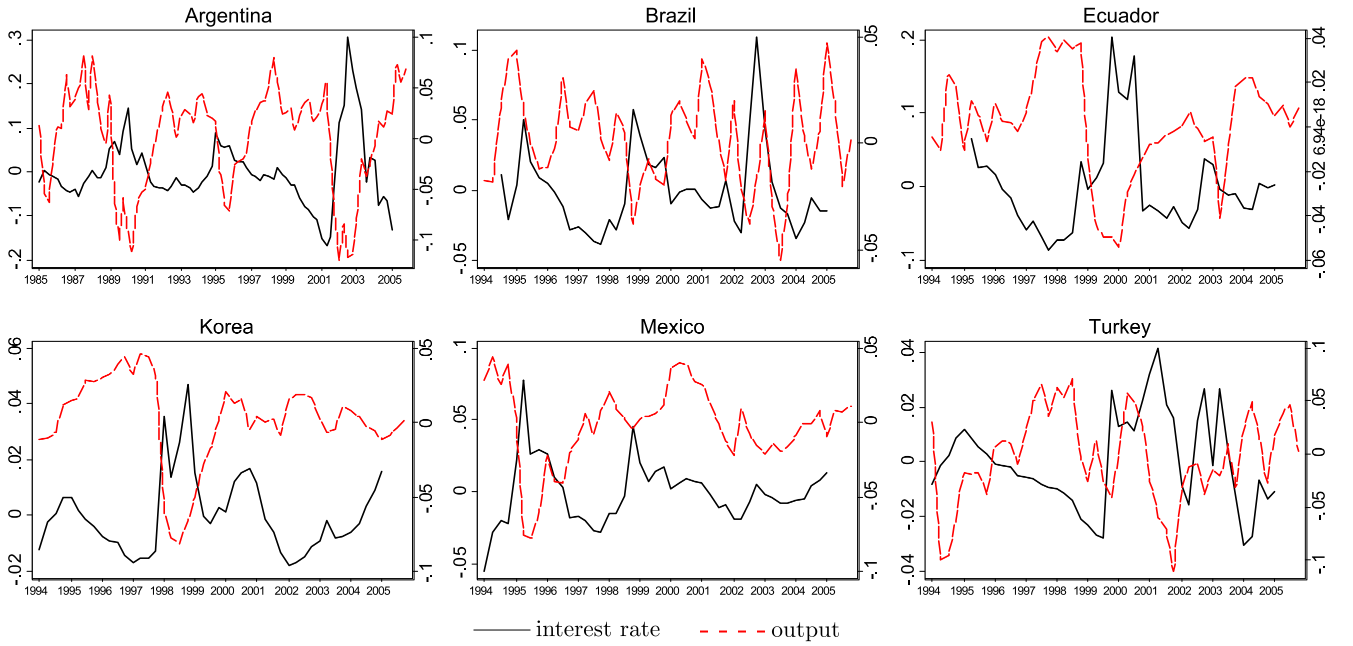

Fig. 3. Output and interest rates in emerging economies.
Note: The time series in the figures are percentage deviations from Hodrick–Prescott filtered trend. Output data (left-hand-side *y*-axes) is seasonally adjusted and in log. Country interest rates (right-hand-side *y*-axes) are real yields on dollar-denominated bonds of emerging countries issued in international financial markets. Data sources: output: IFS; interest rate: EMBI+ (Argentina, Neumeyer and Perri (2005)).

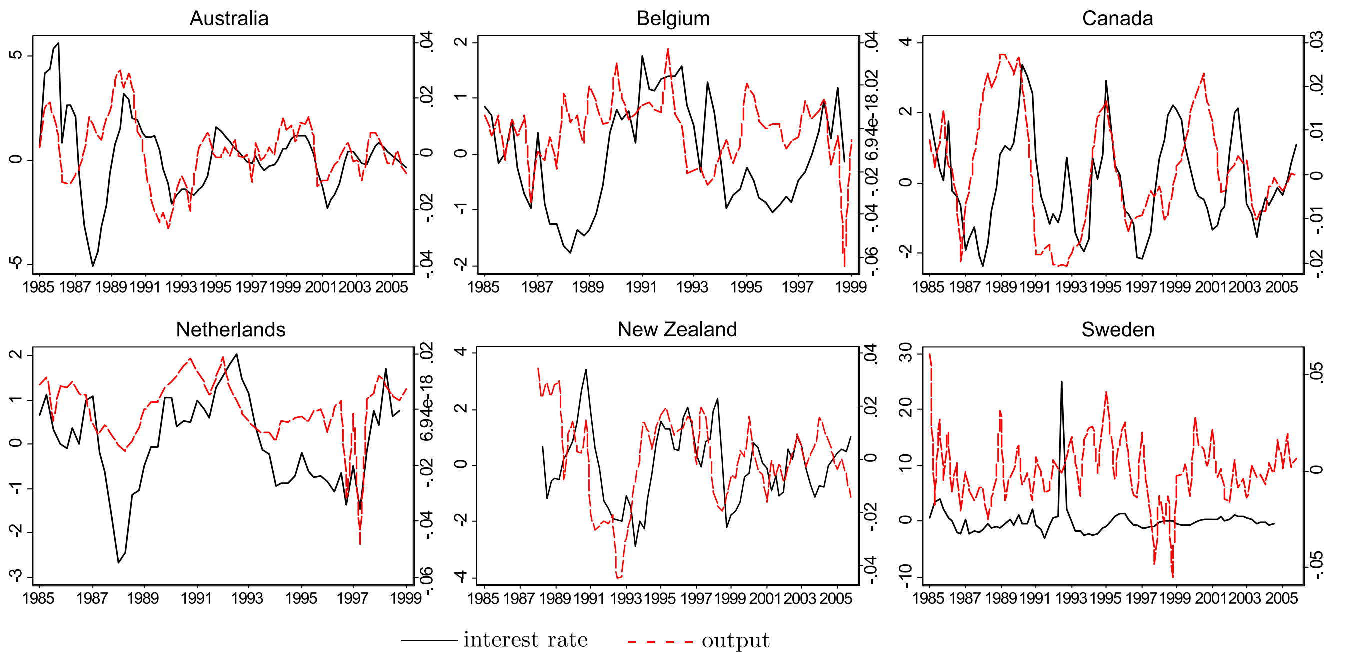

Fig. 4. Output and interest rates in developed economies.
Note: The time series in the figures are percentage deviations from Hodrick–Prescott filtered trend. Output data (left-hand-side *y*-axes) is seasonally adjusted and in log. Country real interest rates are obtained by subtracting the expected 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 sources: IFS, OECD.

rates. The cross-correlation of real wages exhibits a hump for emerging economies, suggesting that in emerging economies, wages are responsive to business cycles and lag the cycle by an average of one quarter, but no systematic pattern exists for developed ones. The real interest rates are consistent with previous findings that interest rates tend to lead the business cycle and are negatively correlated with the cycle in emerging markets, which is the opposite of the evidence in developed economies.

One concern with the evidence documented in Table 1 is the measurement error in emerging-market data at quarterly frequency. In Appendix B, we also report the business cycle statistics using annual data on the real wage and output over a longer time period. The annual evidence is generally consistent with the quarterly observations except for some discrep-

Table 1
Volatility and correlation of wage with output.

	Output	Overall activity wage				Manufacturing wage			
	$\sigma(y)$	$\frac{\sigma(w)}{\sigma(y)}$	$\rho(y,w)$	95% confidence	$\rho(r,w)$	$\frac{\sigma(w)}{\sigma(y)}$	$\rho(y,w)$	95% confidence	$\rho(r,w)$
Emerging economies									
Argentina	3.04					1.38	0.24	(−0.14, 0.57)	−0.21
Brazil	2.39	2.67	0.13	(−0.13, 0.37)	0.09				
Chile	2.91	0.71	0.52	(0.28, 0.70)		0.71	0.45	(0.19, 0.66)	
Czech Republic	1.53	1.90	0.45	(0.18, 0.66)		1.35	0.55	(0.30, 0.73)	
Ecuador	2.28	3.51	0.56	(0.33, 0.72)	−0.48				
Hong Kong	3.24	0.48	0.51	(0.28, 0.69)					
Israel	2.36	0.94	0.22	(−0.04, 0.45)		0.86	0.16	(−0.08, 0.40)	
Korea	2.56	1.20	0.65	(0.56, 0.73)	−0.57	1.50	0.75	(0.67, 0.85)	−0.52
Mexico	2.41					1.91	0.41	(0.21, 0.57)	−0.34
Philippines	0.83	1.60	−0.19	(−0.62, 0.31)	−0.15				
Russia	3.53	3.01	0.08	(−0.21, 0.38)	−0.79				
Singapore	3.05	0.91	−0.06	(−0.33, 0.21)		0.36	0.05	(−0.26, 0.36)	
Slovak Republic	1.01	3.55	0.48	(0.32, 0.61)		2.70	0.70	(0.53, 0.81)	
Taiwan	2.23	0.83	0.43	(0.17, 0.63)		0.51	0.47	(0.24, 0.67)	
Turkey	4.32					1.69	0.32	(0.05, 0.54)	0.00
Average	2.51	1.78	0.32	(0.07, 0.56)	−0.38	1.29	0.41	(0.17, 0.62)	−0.27
Weighted average	2.71	2.03	0.31	(0.01, 0.54)	−0.36	1.18	0.50	(0.24, 0.64)	−0.31
Developed economies									
Australia	1.16	1.03	−0.12	(−0.33, 0.09)	−0.19	1.91	0.16	(−0.05, 0.36)	0.07
Austria	1.24	0.80	0.00	(−0.31, 0.31)	−0.15	0.56	0.20	(−0.02, 0.40)	0.26
Belgium	1.45	0.45	0.06	(−0.16, 0.27)	0.44	0.48	0.00	(−0.22, 0.21)	0.43
Canada	1.31					0.60	−0.28	(−0.47, −0.08)	−0.23
Denmark	1.74	0.28	−0.34	(−0.57, −0.06)	−0.04	0.49	−0.07	(−0.28, 0.14)	0.05
France	0.90	0.61	0.43	(0.24, 0.59)	0.41	0.60	0.44	(0.25, 0.60)	0.41
Germany	1.84	0.76	−0.13	(−0.34, 0.10)	−0.10	0.46	−0.01	(−0.22, 0.21)	−0.23
Italy	1.07	0.88	−0.27	(−0.46, −0.06)	−0.16	0.87	−0.31	(−0.46, −0.10)	−0.16
Japan	1.25	0.81	−0.03	(−0.24, 0.19)	−0.08	0.78	0.31	(0.10, 0.49)	0.26
Netherlands	1.09	0.62	−0.14	(−0.37, 0.11)	−0.01	0.57	−0.15	(−0.38, 0.10)	0.01
New Zealand	2.11	0.48	−0.20	(−0.41, 0.03)	−0.53	0.41	−0.32	(−0.52, −0.09)	−0.59
Norway	1.67					0.74	0.15	(−0.07, 0.35)	0.05
Sweden	1.67	0.41	−0.02	(−0.33, 0.29)		0.90	0.19	(−0.03, 0.39)	0.07
United Kingdom	1.14	0.76	0.27	(0.09, 0.45)	−0.59	0.8	0.34	(0.13, 0.52)	−0.54
United States	0.96					0.58	−0.09	(−0.29, 0.13)	−0.51
Average	1.37	0.66	−0.04	(−0.27, 0.19)	−0.09	0.72	0.04	(−0.17, 0.24)	−0.04
Weighted average	1.15	0.74	0.01	(−0.23, 0.26)	−0.09	0.67	0.04	(−0.16, 0.24)	−0.21
t-statistics	4.48	3.37	3.55		−1.43	2.34	3.94		−2.42

Notes: The variables are deseasonalized and detrended real GDP (y), the real wage rate in all sectors and the real wage rate in manufacturing sector (w) and real interest rate (r). All statistics are based on quarterly data 1985Q1:2005Q4 (although data are only available beginning in early 1990s 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. The weighted average is weighted by country size, average real GDP (in U.S. dollar) over the sample period. t-statistics reported in the last row are obtained running the mean comparison test across emerging economies and developed economies.

ancies. For instance, 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 fluctuations at quarterly frequencies in emerging markets but at annual frequencies in developed economies. Another concern with Table 1 is the comparability of different datasets. As shown in the appendix, the patterns prevail in the subset of countries with U.S. Bureau of Labor Statistics data, with a closely comparable methodology.

It would be odd to study the price of the labor market without understanding the quantity – labor input. However, the labor input data is rarely available for emerging economies, and the existing data often display severe measurement problems, as noted by various researchers. Providing a complete and thorough study of the cyclical labor input in emerging economies is beyond the scope of this paper, but the existing empirical evidence seems to suggest that the labor input (both when it is measured by extensive margin – employment and when measured by total working hours) is slightly less responsive in emerging markets than in developed economies, as presented in Table 2. The relative labor volatility is lower in emerging economies by 12% or 58%, and the average contemporaneous correlation is smaller by 0.15.

2.3. Discussion

One concern with the result is that it is based on the aggregated real wage data. The problem with using aggregate data is that it implicitly assumes that the composition of employment does not vary over the business cycle and that the cyclical

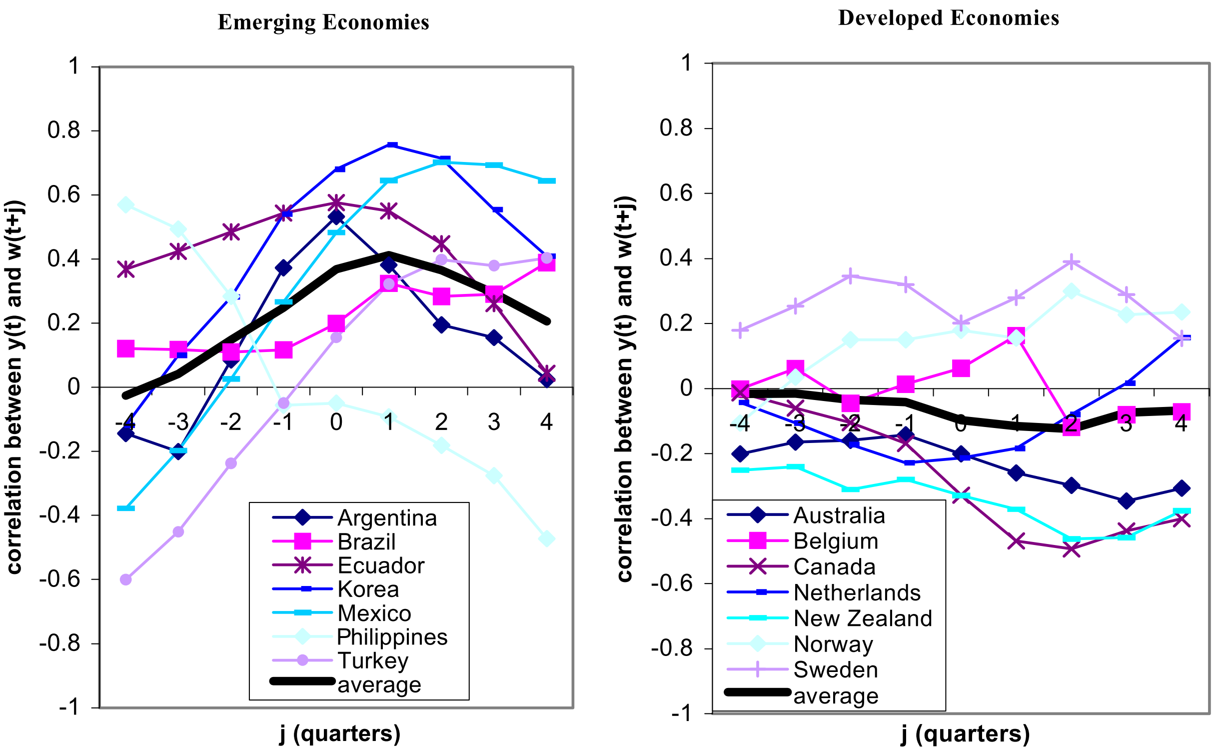

Fig. 5. Cross-correlation between output and wage.

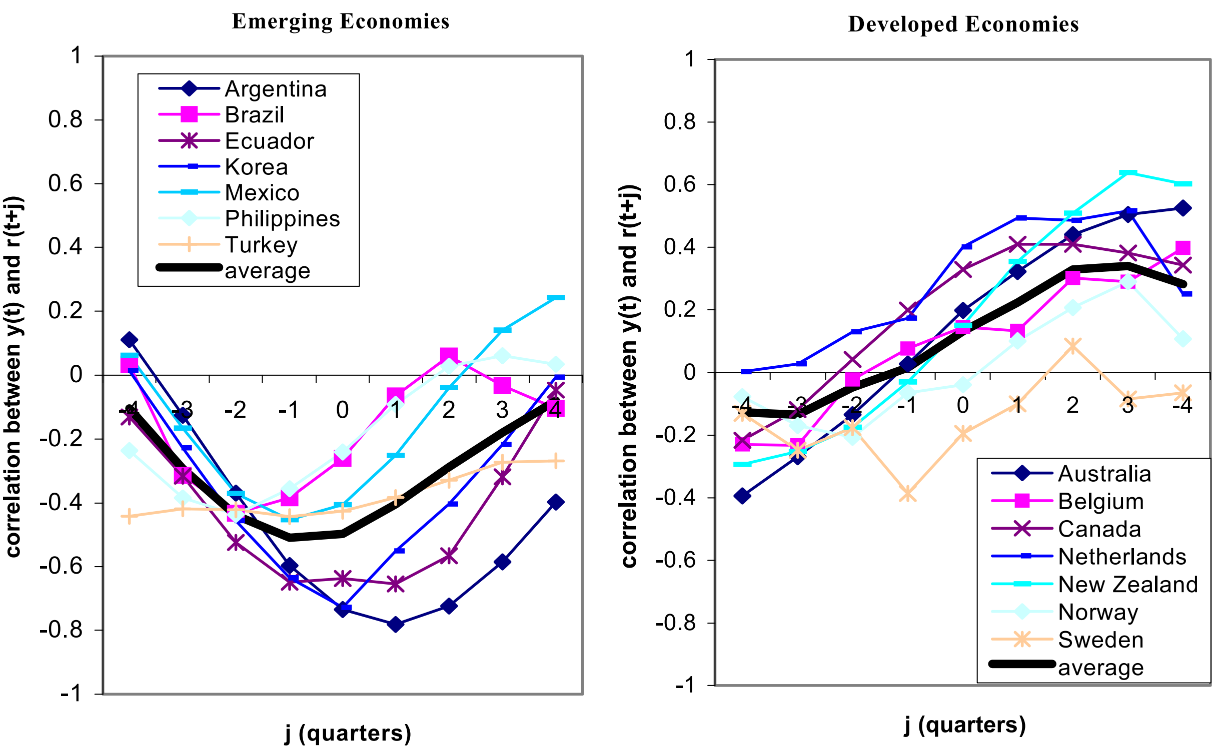

Fig. 6. Cross-correlation between output and interest rate.

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 workers with lower skills and less work experience often face more procyclical wages, aggregation using individual income as the weight causes downward biases in the wage cyclicality. Given this, one would expect this effect of countercyclical bias to be 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

Table 2
Volatility and correlation of labor input and output.

	$\frac{\sigma(H)}{\sigma(y)}$	$\rho(y,H)$	$\frac{\sigma(E)}{\sigma(y)}$	$\rho(y,E)$		$\frac{\sigma(H)}{\sigma(y)}$	$\rho(y,H)$	$\frac{\sigma(E)}{\sigma(y)}$	$\rho(y,E)$
Emerging economies					Developed economies				
Argentina	0.57	0.52	0.39	0.36	Australia	1.58	0.62	1.10	0.59
Brazil	1.64	0.54	0.63	0.63	Belgium			0.63	0.50
Czech Republic			0.49	0.18	Canada	0.79	0.59	0.64	0.81
Hungary	1.41	0.22	1.16	0.15	Denmark			0.48	0.41
Korea	0.79	0.33	0.68	0.89	New Zealand			0.75	0.31
Mexico	0.77	0.60	0.48	0.45	Norway	1.16	0.39	0.77	0.40
Slovak Republic			0.76	0.76	Spain	1.52	0.70	1.28	0.80
Turkey	1.47	0.51	0.60	−0.10	Sweden	1.13	0.68	2.62	0.78
Average	1.11	0.45	0.65	0.42	Average	1.24	0.60	1.03	0.57

Note: The variables are deseasonalized and detrended real GDP (y), employment (E) and total hours worked (H). All statistics are based on quarterly data 1985Q1:2005Q4 for developed economies, and 1988Q1:2005Q4 for most emerging economies. Data sources: OECD, Neumeyer and Perri (2005).

exit of lower income workers from the labor force. This higher volatility of the extensive margin may cause more volatile aggregate wage fluctuation in emerging markets compared to developed economies. Although it is important and interesting, the composition effect is not explored in this paper due to data limitations.

3. The model economy

The model is a small open economy with a working capital constraint, similar to Neumeyer and Perri (2005). There is a single good and a single asset (i.e. a one-period, non-state-contingent internationally traded real bond). We consider a hybrid form of the utility function proposed by Jaimovich and Rebelo (2009) (JR preference henceforth) to allow flexible intensity of income effect and a standard quadratic labor adjustment cost to explore the role of labor demand on wage fluctuations.

3.1. Households

The economy is populated with a large number of infinitely lived identical agents who derive utility from consumption, c_t, and disutility from hours worked, l_t. Their preferences are given by:

$$U = E_0 \sum \beta^t \frac{(c_t - b l_t^{\nu} x_t)^{1-\sigma} - 1}{1-\sigma},$$

where

$$x_t = c_t^{\gamma} x_{t-1}^{1-\gamma}, \tag{1}$$

and assume that the discount factor $0 < \beta < 1$, $\nu > 1$, b, $\sigma > 0$. The parameter γ governs the strength of the income effect in labor supply. As pointed out by Jaimovich and Rebelo (2009), this preference specification nests two special cases of utility functions: the preference proposed by Greenwood et al. (1988) (GHH preference henceforth) (when $\gamma = 0$) and the preference discussed in King et al. (1988) (KPR preference henceforth) (when $\gamma = 1$). With the GHH preference, the wealth effect is completely eliminated and the labor supply decision is independent of intertemporal considerations. When $0 < \gamma < 1$, the short-run impact of the wage increase on labor supply is between that generated with GHH and KPR preferences.

Households own all the firms and have access to capital and financial asset markets and have three sources of income: wage income, capital rents and net borrowing from the international financial market. Each period the representative household chooses consumption, labor supply, physical capital investment, i_t, international debt position, d_t, subject to its period-by-period budget constraint

$$c_t + i_t - d_t \leqslant w_t l_t + r_t^k k_t - d_{t-1}(1 + r_{t-1}), \tag{2}$$

where w_t denotes the wage rate, r_t^k is the rental rate of physical capital, r_t is the prevailing interest rate faced by the economic agents in the financial market.

Capital accumulation follows the following law of motion: $k_{t+1} = i_t + (1-\delta)k_t - \frac{\phi}{2}(\frac{k_{t+1}-k_t}{k_t})^2 k_t$, $\phi > 0$, where $0 < \delta < 1$ denotes the depreciation rate of physical capital and the last term is the cost of adjusting capital. 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.

The first-order conditions for per-period consumption, consumption stock, hours worked and physical investment are

$$\left(c_t - bl_t^{\nu} x_t\right)^{-\sigma} + \mu_t \gamma (c_t / x_{t-1})^{\gamma-1} = \lambda_t, \tag{3}$$

$$\left(c_t - bl_t^{\nu} x_t\right)^{-\sigma} bl_t^{\nu} + \mu_t = \beta E_t\left[\mu_{t+1}(1-\gamma) c_{t+1}^{\gamma} x_t^{-\gamma}\right], \tag{4}$$

$$\nu bl_t^{\nu-1} x_t \left(c_t - bl_t^{\nu} x_t\right)^{-\sigma} = \lambda_t w_t, \tag{5}$$

$$\lambda_t\left[1 + \phi\left(\frac{k_{t+1} - k_t}{k_t}\right)\right] = \beta E_t \lambda_{t+1}\left[r_{t+1}^k + (1-\delta) + \phi\left(\frac{k_{t+2} - k_{t+1}}{k_{t+1}}\right)\frac{k_{t+2}}{k_{t+1}}\right], \tag{6}$$

$$\lambda_t = \beta E_t \lambda_{t+1}(1 + r_t), \tag{7}$$

where μ_t and λ_t are the Lagrange multipliers associated with Eqs. (1) and (2). Intuitively, μ_t captures the marginal value of consumption stock or consumption habit. It is given by the continuation value of a per unit increase in the consumption stock subtracted by the increased disutility of work, because, under this preference, the disutility of work is high when the consumption habit is high.

3.2. Firms

The single output is used for both consumption and investment and is produced by firms with a Cobb–Douglas production function that requires capital inputs and labor services, $F(k_t, l_t; A_t) = A_t k_t^{\alpha} l_t^{1-\alpha}$, where $0 < \alpha < 1$ represents the capital share. In addition, firms face a quadratic labor adjustment cost whenever changing labor inputs, which affects output directly. Hence,

$$y_t = A_t k_t^{\alpha} l_t^{1-\alpha} - \frac{\tau}{2}\left(\frac{l_t - l_{t-1}}{l_{t-1}}\right)^2 l_{t-1}, \tag{8}$$

where $\tau \geqslant 0$ is the labor adjustment cost parameter. As firms pay the adjustment cost for net, not gross, change in the labor input, the cost is assumed to be a function of the difference between the stock of labor hours in the current period and the stock from the previous period.

Employers have to borrow a fraction, θ ($\geqslant 0$), 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 and has to be paid back before the end of the period. At the optimum, the working capital constraint binds. In addition, labor adjustment is costly. Hence, the employer's net cash flow equals output less wage payments, working capital repayments with interest, and rental costs of physical capital. With the presence of the labor adjustment cost, firms maximize the discounted present value of future profit flows using the common stochastic discount factor as households,

$$\pi_t = E_0 \sum_{t=0}^{\infty} \beta \frac{\lambda_{t+1}}{\lambda_t}\left[A_t k_t^{\alpha} l_t^{1-\alpha} - w_t l_t (1 + \theta r_{t-1}) - r_t^k k_t - \frac{\tau}{2}\left(\frac{l_t - l_{t-1}}{l_{t-1}}\right)^2 l_{t-1}\right] \tag{9}$$

in which $\theta r_{t-1} w_t l_t$ is the net debt position of the firm and r_t^k denotes the rental rate of capital. The working capital constraint increases with 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.

The optimal labor demand satisfies

$$(1 + r_{t-1}\theta) w_t = (1-\alpha) A_t k_t^{\alpha} l_t^{-\alpha} - \tau\left(\frac{l_t - l_{t-1}}{l_{t-1}}\right) + E_t \beta \frac{\lambda_{t+1}}{\lambda_t}\left[\tau\left(\frac{l_{t+1} - l_t}{l_t}\right)\frac{l_{t+1}}{l_t}\right]. \tag{10}$$

The last term represents the intertemporal effect of current changes in labor hours on the future cost of adjusting labor. The first-order condition for capital stock states that

$$r_t^k = \alpha A_t k_t^{\alpha-1} l_t^{1-\alpha}. \tag{11}$$

3.3. Interest rates and financial intermediation

The interest rate process is characterized as a combination of the exogenous international interest rate, r^*, and an endogenous risk premium component expressed as a function of the net external debt position

$$r_t = r_t^* + \kappa\left[\exp(d_t / y_t - \bar{d}) - 1\right] \tag{12}$$

in which $\bar{d}$ denotes the steady-state level of debt as a fraction of output, and $\kappa > 0$ governs the elasticity of interest rates with respect to changes in net debt position. 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.) and the higher the premium. When choosing the optimal debt position, the household does not internalize its contribution to the aggregate debt position. This specification is typically assumed in small open economy models to induce stationarity in the equilibrium dynamics (see Schmitt-Grohe and Uribe, 2003).[11]

Emerging markets borrow heavily in 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 has 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. Hence, country interest rates in emerging markets are countercyclical.

3.4. *Equilibrium allocation and prices*

Given the initial state and conditions k_0 and d_0, and a sequence of realizations of shocks to interest rates $\{r_t^*\}_{t=0}^{\infty}$ and productivity $\{A_t\}_{t=0}^{\infty}$, a competitive equilibrium in a small open economy is a state-contingent sequence of allocations $\{c_t, l_t, k_t, d_t\}_{t=0}^{\infty}$, and a sequence of wages $\{w_t\}_{t=0}^{\infty}$ such that (a) the allocations solve the household's and the firm's problems at equilibrium prices for all states and periods; and (b) factor market and goods market clear $c_t + i_t + tb_t = y_t$, where the trade balance is given by $tb_t = d_{t-1}(1 + r_{t-1}) - d_t + \theta w_t l_t r_{t-1}$; and (c) non-Ponzi scheme condition, $\lim_{t\to\infty} d_t/\Pi_{\tau=1}^{t-1}(1 + r_\tau) = 0$.

4. Quantitative analysis

4.1. *Calibration of parameter values and shock processes*

4.1.1. *Parameter values*

Data from Mexico (1994:1–2005:4) is used to estimate some parameters governing stochastic shocks, preferences, production and adjustment costs. The discount factor β equals 0.98 to match the EMBI+ spread generated real interest rate of 8.15% per year for Mexico over the sample period. The household's risk aversion parameter, σ, is set to 2 and the depreciation rate δ to 0.03. The capital share parameter α is set to be 0.32 as in Mendoza (1991).

Microeconomic evidence on this parameter is generally based on the U.S. observations and the estimated intertemporal (Frisch) elasticity of labor elasticity is small.[12] The leading contribution to estimation of this parameter is by Pistaferri (2003), where he finds the elasticity to be 0.69 using data on workers' personal expectations of wage change. This implies $\nu = 2.44$ with the GHH preference.[13] Given the labor supply elasticity, the other preference parameter, $b = 3.72$ to match the average ratio of hours worked to total nonsleeping hours of the working age population as 32% according to OECD Annual Hours and Productivity data (2002) for Mexico.

In addition, the working capital parameter, θ, is chosen to be 1 following Neumeyer and Perri (2005). The coefficient on the interest rate premium, κ, equals 0.01 as used in the literature (Schmitt-Grohe and Uribe, 2003; Aguiar and Gopinath, 2007). The capital adjustment cost parameter ϕ is set so that the relative volatility of investment and volatility of trade-to-GDP ratio are close to the Mexico data. The net external debt position at the steady state is 44% according to Lane and Milesi-Ferretti (2006) in Mexico over the sample period. Finally, in our baseline model $\gamma = 0.1$, which implies an intensity of the wealth effects that is between the GHH and KPR preference specifications. We consider no labor adjustment cost (i.e. $\tau = 0$), in the baseline model and $\tau = 5$ to match the relative volatility between hours and output in another case.

4.1.2. *Shock processes*

The model dynamics are driven by two exogenous stochastic disturbances that affect domestic total factor productivity and the real interest rate. The detailed discussions of the country default risk and the interest rate process in emerging markets are provided in Neumeyer and Perri (2005) and Uribe and Yue (2006). In this paper, we take a simpler stand by assuming that the underlying shocks follow a VAR(1) process.[14] Specifically, let the variable $\hat{A}_t$ and $\hat{r}_t$ denote the deviations

[11] One can also derive the above equation 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 the external financial market at interest rate r_t^*, and lend to domestic agents at interest rate r_t. Individual competitive banks do not internalize the cost. Rather, they maximize the end-of-period profit

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

by choosing their individual loans. This leads to Eq. (12) in equilibrium.

[12] For example, Pencavel (1986) reports the value is around 0.2. Blundell and MaCurdy (1999) estimate the intertemporal elasticity of labor supply to be in the range [0.5, 1].

[13] In Greenwood et al. (1988), ν is one plus the inverse of the intertemporal (Frisch) elasticity of labor supply.

[14] Furthermore, the nature of the shock processes in developed economies and emerging economies can be sufficiently different. As emphasized in Aguiar and Gopinath (2007), the trend shock component is more significant than the temporary shock for emerging markets. However, this evidence is not conclusive, as recent research shows that the relative variance of permanent TFP shocks to transitory shocks does not differ much between emerging and developed economies (Garcia-Cicco et al., 2006 and Boz et al., 2008).

of A_t (in log) and r_t from their HP filtered trend. We assume they are determined by the first-order vector autoregressive process as below:

$$\begin{bmatrix} \hat{A}_t \\ \hat{r}_t^* \end{bmatrix} = \begin{bmatrix} \rho_A & 0 \\ 0 & \rho_r \end{bmatrix} \begin{bmatrix} \hat{A}_{t-1} \\ \hat{r}_{t-1}^* \end{bmatrix} + \begin{bmatrix} \varepsilon_{A,t} \\ \varepsilon_{r,t} \end{bmatrix}, \tag{13}$$

where ρ_A and ρ_r are the autocorrelation coefficients of productivity and real interest rate shocks respectively. $\varepsilon = [\varepsilon_{A,t}, \varepsilon_{r,t}]'$ is the shock process to the total factor productivity and the real interest rate. $E[\varepsilon_t] = 0_{2\times 1}$, and $E[\varepsilon_t \varepsilon_s] = \left[\begin{smallmatrix} \sigma^2_{\varepsilon_A} & \rho_{\varepsilon_r,\varepsilon_A}\sigma_{\varepsilon_A}\sigma_{\varepsilon_r} \\ \rho_{\varepsilon_r,\varepsilon_A}\sigma_{\varepsilon_A}\sigma_{\varepsilon_r} & \sigma^2_{\varepsilon_r} \end{smallmatrix}\right]$, if $t = s$ and 0 otherwise.

We construct quarterly Solow residuals by using the Mexican data. There are some general problems associated with estimating Solow residuals, such as the existence of variable capital utilization, imperfect competition and capital adjustment costs. Especially for developing economies, the data availability is limited and the quality of the data on capital formation, employment, working hours is relatively low. Nevertheless, we 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).

Using the total labor hours as the labor input series, we estimate $\rho_A = 0.71$. The persistence of the interest rate shocks is much lower, $\rho_r = 0.53$.[15] The standard deviation of innovations to TFP and real interest rate are set to be 1% and 2%. As shown in the empirical section, interest rates in emerging markets are negatively correlated with business cycles. Empirically, we find that $\rho_{\varepsilon_r,\varepsilon_A} = -0.5$.

In addition, we also consider an alternative shock structure. Neumeyer and Perri (2005) show that when country risk is induced by local economic fundamentals such as productivity shocks, the model can account for most empirical regularities well. We consider a similar approach, where the country interest rate at which firms borrow is negatively related to the expected TFP in the next period. Specifically,

$$\hat{A}_{t+1} = \tilde{\rho}_A \hat{A}_t + \tilde{\varepsilon}_A, \tag{14}$$

$$\hat{r}_t = -aE_t\hat{A}_{t+1} + \tilde{\varepsilon}_r, \tag{15}$$

where both $\tilde{\varepsilon}_A$ and $\tilde{\varepsilon}_r$ are normal distributed independent shocks. $\tilde{\rho}_A = 0.75$ is estimated from the data and $\sigma(\tilde{\varepsilon}_A) = 1\%$. We set $a = 1.5$ and $\sigma(\tilde{\varepsilon}_r) = 1.5\%$ in order to match the persistence and variance of the country interest rate in Mexico.

4.2. Characterization of equilibrium

In this section we discuss the role played by the JR preference on labor supply. In discussing the influence of preferences on labor and wage determination, it is useful to consider two versions of the model with two extreme values of γ first (i.e. $\gamma = 0$ and $\gamma = 1$). The intensity of wealth effect increases as γ rises. In both cases, there is no labor adjustment cost to simplify the analysis.

4.2.1. GHH preference

When $\gamma = 0$, $x_t = x_0$, we obtain the preferences proposed by Greenwood et al. (1988). This formulation of momentary utility function has been shown to play a crucial role in allowing RBC-SOE models to produce realistic consumption volatilities and countercyclical trade balances for emerging-market economies (Correia et al., 1995). The linearized first-order condition on optimal debt yields[16]

$$\hat{c}_{t+1} - \hat{c}_t = \frac{1}{\sigma}\left(1 - \frac{\bar{z}}{\nu}\right)\frac{\bar{r}}{1+\bar{r}}\hat{r}_t + \bar{z}(\hat{l}_{t+1} - \hat{l}_t),$$

where $\bar{z} = \bar{w}\bar{l}/\bar{c}$ is the steady-state ratio between the employer's labor income and consumption. If interest rate shocks are large relative to productivity shocks, the combination of the two effects – intertemporal substitution effect (the first term) and the indirect effect derived from growth of the labor input (the second term) – generates a larger response of consumption than output (as shown in Neumeyer and Perri, 2005). Specifically, higher interest rates induce more saving and less current consumption and cause a fall in the labor input for the next period, while leaving current employment unchanged. As a consequence, consumption drops immediately and falls more than output, and the trade balance is more likely to display strong countercyclicality.

However, GHH preference specification meets its limitation when it comes to understanding the labor market fluctuations. By design, with this type of preference, the marginal rate of substitution between consumption and labor supply is independent of the consumption decision. Therefore, it completely rules out the income effect, and labor supply decisions are not associated with intertemporal considerations. In other words, labor is fully responsive to the current shocks, leaving

[15] The Solow residuals generated by these two labor input series (employment and total labor hours) display similar persistence, volatility and correlation with the interest rate.

[16] Let $\hat{x}$ denote $\log x - \log\bar{x}$, where x is any variable and $\bar{x}$ is its steady-state value.

less room for the wage to adjust. Since employment fully responds to the exogenous shocks, the calibration of the model suggests that the workers' wage does not display enough volatility and always has a large positive correlation with output with the GHH preference.

To illustrate this point analytically, we combine Eqs. (5) and (10), which say the real wage equates with both the marginal product of labor adjusted by financial cost of employing labor and the marginal rate of substitution between consumption and leisure:

$$\nu b l_t^{\nu-1} x_0 = w_t = \frac{(1-\alpha)A_t k_t^{\alpha} l_t^{-\alpha}}{1+\theta r_{t-1}} = \frac{(1-\alpha)}{1+\theta r_{t-1}}\frac{y_t}{l_t}. \tag{16}$$

An increase in the interest rate enlarges employers' borrowing cost of working capital, reducing the labor demand of the next period. Hence, a countercyclical interest rate shock simply amplifies the productivity shock. The linearization of Eq. (16) around the steady state generates

$$\hat{l}_t = \frac{1}{\eta_s^{-1} - \eta_d^{-1}}\left(\hat{A}_t + \alpha \hat{k}_t - \frac{\bar{r}\theta}{1+\bar{r}\theta}\hat{r}_{t-1}\right), \tag{17}$$

$$\hat{w}_t = (\nu - 1)\hat{l}_t = \frac{1}{\eta_s + 1}\left(\hat{y}_t - \frac{\bar{r}\theta}{1+\bar{r}\theta}\hat{r}_{t-1}\right), \tag{18}$$

where $\eta_s = 1/(\nu - 1)$ represents the (Frisch) elasticity of labor supply and $\eta_d = 1/\alpha$ is the elasticity of labor demand. The change in wage is a fraction of the change in labor, with the proportion determined negatively by the elasticity of labor supply.

Empirical evidence indicates that the standard deviation of GDP per capita ($\sigma(y)$) in emerging markets is around 2.5%, $\sigma(r)$ is of similar magnitude if not smaller and the correlation between these two is about -0.5. Given these values, high values of ν translate into high values of $\sigma(w)$. Suppose $\nu = 2.44$, corresponding to intertemporal (Frisch) elasticity of labor elasticity of 0.69. For these values, we can infer that the relative volatility of wage vis-à-vis that of output ($\sigma(w)/\sigma(y)$) ranges between 59% (when $\theta = 0$) and 70% (when $\theta = 1$). With reasonable parameter values, it is impossible to raise the variation of wage above that of output.

4.2.2. KPR preference

Now consider the case when $\gamma = 1$, which gives the standard KPR preference. The model with KPR preferences behaves quite differently. The labor supply choices decrease with the consumption level. Again, combining the household's optimal labor supply decision with the firm's optimal labor demand decision, we have

$$c_t \frac{\nu b l_t^{\nu-1}}{1 - b l_t^{\nu}} = w_t = \frac{(1-\alpha)A_t k_t^{\alpha} l_t^{-\alpha}}{1+\theta r_{t-1}} = \frac{(1-\alpha)}{1+\theta r_{t-1}}\frac{y_t}{l_t}. \tag{19}$$

The linearized optimal labor input and equilibrium wage are

$$\hat{l}_t = \frac{1}{\nu - 1 + \alpha + \bar{z}}\left(\hat{A}_t + \alpha \hat{k}_t - \frac{\theta\bar{r}}{1+\theta\bar{r}}\hat{r}_{t-1} - \hat{c}_t\right), \tag{20}$$

$$\hat{w}_t = (\nu - 1 + \bar{z})\hat{l}_t + \hat{c}_t. \tag{21}$$

Compared with the optimal labor input in Eq. (17), the response of the labor input to shocks is mitigated and depends on two more elements: the wage compensation to consumption ratio ($\bar{z}$) and the income effect captured by changes in consumption ($\hat{c}_t$). Both have negative impacts on the volatility of labor. In contrast, these two elements increase the responsiveness of the wage to shocks.

Interest rate fluctuations affect wages through two channels. Suppose that output drops. First, the rising interest rate, through the working capital constraint, directly increases the cost of financing the wage bill. Other things equal, 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, an increase in interest rates induces households to save more since the current consumption is more expensive than the future consumption. Although the efficiency condition implies a negative shift in labor demand, this shift is offset by the negative income effect. Hence, in equilibrium the labor input is not very responsive, while the wage is exposed to more volatility and displays higher procyclicality. The overall magnitude depends on the strength of the income effect, which hinges on the sizes and interaction of the TFP shocks and the countercyclical interest rate fluctuations.

Analytically, we can express the wage fluctuation as a weighted average of fluctuations in output net interest rates on working capital borrowing and variations in consumption:

$$\hat{w}_t = \left(1 - \frac{1}{\bar{z}+\nu}\right)\left(\hat{y}_t - \frac{\bar{r}\theta}{1+\bar{r}\theta}\hat{r}_{t-1}\right) + \frac{1}{\bar{z}+\nu}\hat{c}_t.$$

This equation shows that as long as consumption is more volatile than output, the model can succeed in generating the equilibrium wage to be more volatile than output for emerging-market economies.

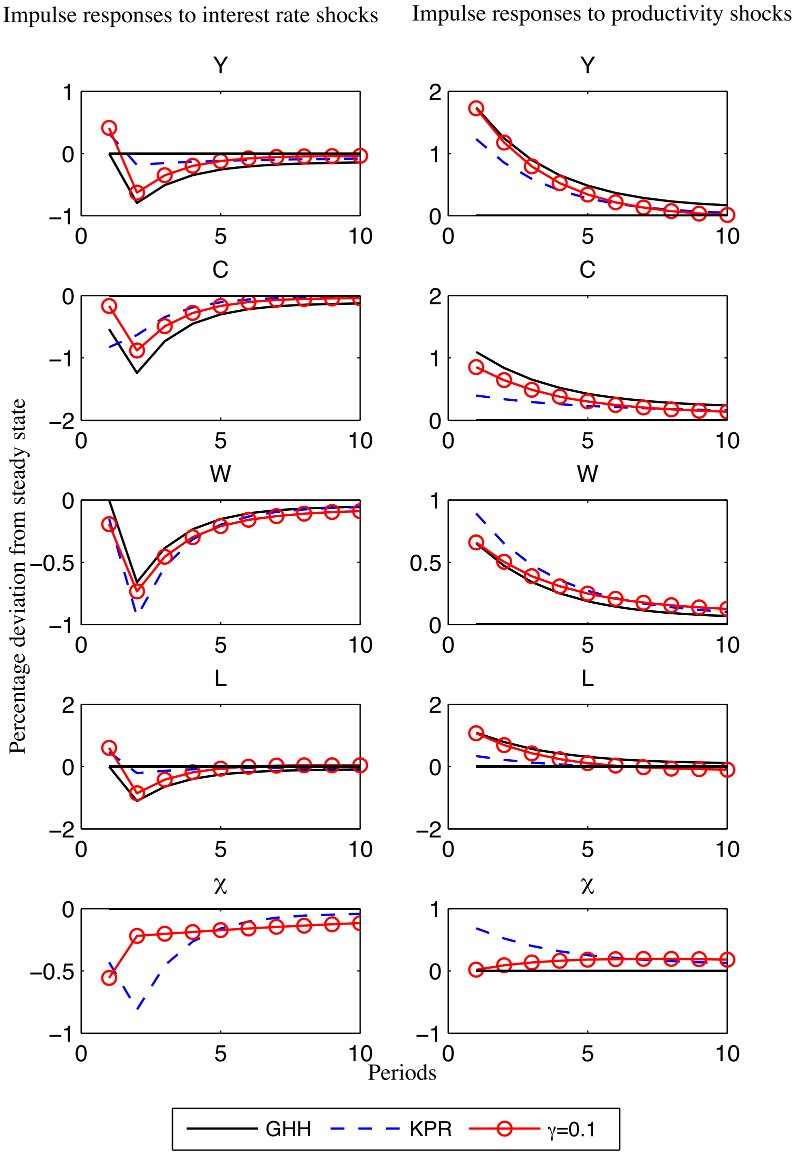

Fig. 7. Impulse responses to independent shocks under different preferences.

However, there are two disadvantages with the KPR utility. First, smoothing the marginal utility of consumption (i.e. Eq. (7)) usually implies a smoother consumption schedule, and consequently, it proves harder to generate trade balance that is largely negatively correlated with output. Second, the same shock process cannot generate enough output volatility because the labor response is subdued.

4.2.3. Impulse responses

To get a closer look at the dynamics of the income effect on the labor supply and wages, we study the impulse responses of key macro variables from a 1% innovation to the level of interest rate (i.e. $\varepsilon_r = 0.01$) with the impulse response to a 1% innovation to TFP (i.e. $\varepsilon_A = 0.01$). Fig. 7 contrasts the impulse responses for three different values of γ: 0, 0.1, and 1. In all cases, there is no correlation between interest rate shocks and TFP shocks (i.e. $\rho_{\varepsilon_A,\varepsilon_r} = 0$).

Under the GHH preference, the interest rate shock does not affect the current wage, labor and output until the next period, because it has no impact on the current financial cost of hiring labor and thereby does not shift the labor demand. Since the labor supply does not depend on the household's intertemporal decisions, the contemporaneous labor market variables do not respond to the interest rate shock. However, consumption drops immediately and responds to the interest rate shock with a larger magnitude than output, which is the opposite of their responses to the TFP shock.

In contrast, under KPR, the responses of all variables except for wage to both shocks are weaker. In fact, the strongest wage response occurs with KPR preferences, because our parameterization implies such a strong income effect on labor supply that in response to an increase in interest rate, initial hours even jumps instead of falling. Notice that consumption decreases the most on impact under KPR. This significant reduction in consumption results in a low equilibrium wage. Together with the TFP shock, during bad times households do not cut back their labor supply as much despite of the low labor productivity and considerably low wage.

When γ is equal to 0.1, the income effect is present but mitigated. The short-run impacts of the shocks on all variables lie between those obtained with GHH and KPR preferences. To study the income effect in response to an interest rate shock in this case, we combine Eqs. (3) and (5) and get $\nu bl_t^{\nu-1}\chi_t = w_t$, where χ_t captures the income effect. Now the disutility of work depends on two elements: the consumption stock or consumption habit, x_t, and the value of consumption habit relative to the value of current consumption, $(\mu_t x_t)/(\lambda_t c_t)$. Specifically,

$$\chi_t = x_t\left(1 - \gamma \frac{\mu_t}{\lambda_t}\frac{x_t}{c_t}\right). \tag{22}$$

Eq. (22) shows that the relative importance of these two elements is related to parameter γ. When $\gamma = 0$ (i.e. GHH), the disutility of work is completely determined by consumption habit, which is constant in this case. When $\gamma = 1$ (i.e. KPR), $\chi_t = c_t(1-\mu_t/\lambda_t) = c_t^{1-\sigma}(1-bl_t^{\nu})^{-\sigma}$. The disutility of work decreases with current levels of consumption and leisure. When $\gamma = 0.1$, consumption habit does not change much on impact, since γ is small, and slowly decreases since γ is positive. However, the relative value of the consumption stock to the value from current consumption increases significantly. In our baseline economy, even with a low value of γ, the overall effects are sufficient to cause a large decline in the income effect so that, on impact, the labor input even increases by a slightly larger amount than with the KPR preference. Intuitively, when current consumption drops considerably from consumption habit, the disutility of work is no longer important from the workers' prospective and they would rather work even harder. In the second period, when the effect of the interest rate on the financial cost of employment is realized through the working capital channel, the wage drops even more, and this wage effect induces a large decline in labor and output.

In response to a positive productivity shock, the short-run responses of labor and wage are close to those obtained with GHH while in the longer run they are close to those obtained with KPR preferences. This results from the fact that the consumption stock increases over time; the disutility of work is higher in the future than in the present. Therefore, the rise in labor and wage is similar to when there is no income effect in the present and is similar to that with KPR preferences in the future.

4.3. Quantitative results

The main interest of this section is to assess whether the high volatility of wage movements in emerging markets can be attributed to financial factors, especially the observed relationship between interest rate shocks and productivity shocks, in this simple model. To do that, we analyze the statistical properties of model economies using parameters specified in Section 4.1.

We focus on the model's ability to account for the three key empirical regularities highlighted in Section 2 and in the literature: a highly volatile wage, volatile consumption and countercyclical trade balance. Three main experiments are conducted here. First, the model is simulated using the JR preference with $\gamma = 0.1$ and the model economy is driven by shock processes estimated with Mexican data. To explore the role of the JR preference, we also report results from GHH and KPR preferences. Second, a labor adjustment cost is added to the simulation to study the impact of sticky labor adjustment on wage fluctuations. Lastly, the model economy is simulated by feeding in alternative shock structures, including the case when country risk is negatively induced by productivity movements. Finally, to examine the impact of financial market development, we analyze the effect of increasing the debt adjustment parameter on targeted second moments.

4.3.1. Baseline model and alternative preferences

Our main findings are summarized in Table 3. The first column shows the corresponding business cycle models in the data. Column (a) then shows the theoretical moments of the same variables generated by the model economy with the JR utility function ($\gamma = 0.1$) and driven by the shock processes in (13). The baseline model succeeds in generating a wage volatility that is about 31% more volatile than GDP, a consumption profile that is 22% more volatile than GDP and a countercyclical trade balance-to-GDP ratio (-0.22).

To explore the impacts of the wealth effect, column (b) and column (c) present the moments implied by GHH and KPR preferences. As expected, the GHH preference completely rules out the income effect and labor hours are fully responsive to the current TFP shocks and the shocks to the financial cost of hiring labor. This significantly increases output volatility and the correlation between the labor input and GDP to as high as 0.93 (compared to 0.41 in the data). Most importantly, without the income effect, the labor input reduction takes places without much change in wage. In particular, wage variability is lower than output ($\sigma(w)/\sigma(y) = 0.94$).

In contrast, with KPR preferences, a positive interest rate shock induces a large drop in current consumption as it is more expensive now than in the future, amplifying the impact of a negative productivity shock on consumption. Because the income effect is strong in this case, labor hours become much less responsive. The comovement between hours and output in the model (0.49) is close to the data (0.41), the volatility of hours is much subdued and the wage becomes more variable ($\sigma(w)/\sigma(y) = 1.76$). However, the downside with KPR preferences is that the model cannot generate enough GDP fluctuations (1.79 vs. 2.41) with the same shock processes, and the trade balance becomes almost acyclical (-0.06).

4.3.2. Quadratic labor adjustment cost

The major discrepancy between the baseline model and the data is that the model tends to over-predict the procyclicality of both hours (0.77 vs. 0.45) and the wage (0.90 vs. 0.41). This is because with a Walrasian spot labor market, the wage

Table 3
Business cycle statistics: actual and simulated data for Mexico.

	Data	Baseline	Other preferences		L. adj. cost	Other shock structures				$\theta = 0.73$
		$\gamma = 0.1$	GHH	KPR	$\tau = 5$	A only	r only	$\rho_{a,r} = 0$	induced r	
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
% Standard deviation										
y	2.41	2.28	2.99	1.79	2.02	1.89	0.94	2.11	2.47	2.14
r	2.27	2.36	2.36	2.36	2.36	0.00	2.35	2.33	2.27	2.34
tb/y	2.25	2.49	2.92	3.16	2.45	1.08	2.78	2.92	2.13	2.37
$\frac{\text{\% Standard deviation of } x}{\text{\% Standard deviation of GDP}}$										
w	1.91	1.31	0.94	1.76	1.20	0.68	2.38	1.21	1.36	1.17
l	0.41	0.61	0.65	0.43	0.41	0.42	1.14	0.61	0.53	0.52
c	1.26	1.22	1.23	1.59	1.25	0.60	2.23	1.11	1.35	1.15
i	3.69	3.69	3.69	3.69	4.11	0.75	8.36	3.70	3.69	3.77
Correlation with GDP										
w	0.41	0.90	0.93	0.82	0.85	0.96	0.92	0.79	0.97	0.90
l	0.45	0.77	0.93	0.49	0.75	0.92	0.81	0.77	0.71	0.78
c	0.69	0.83	0.91	0.60	0.79	0.85	0.63	0.62	0.97	0.82
i	0.91	0.60	0.64	0.45	0.62	0.79	0.22	0.22	0.88	0.56
tb/y	−0.73	−0.22	−0.37	−0.06	−0.25	0.81	−0.16	0.21	−0.79	−0.15
r	−0.48	−0.51	−0.53	−0.34	−0.55	−0.53	−0.22	−0.11	−0.66	−0.48
Correlation with interest rate										
w	−0.34	−0.63	−0.60	−0.66	−0.72	−0.73	−0.22	−0.50	−0.62	−0.62
l	−0.37	−0.38	−0.60	0.30	−0.56	−0.18	−0.17	−0.14	−0.36	−0.33
c	−0.32	−0.84	−0.80	−0.93	−0.88	−0.89	−0.90	−0.80	−0.77	−0.85
i	−0.51	−0.98	−0.98	−0.98	−0.99	−0.93	−0.99	−0.99	−0.89	−0.99
tb/y	0.55	0.92	0.96	0.94	0.92	0.06	0.99	0.93	0.94	0.91

Note: Theoretical moments are calculated from the model using the parameters and shock processes reported in Section 4.1. See Appendix C for a description of data construction. The capital adjustment cost parameter ϕ is set to 19.38 (in a, d, e, f, g and i), 14.75 (in b), 24.7 (in c) and 22 (in h).

is tightly linked to the marginal productivity of labor. With productivity shocks being the main driving force of the output fluctuations, the wage displays excessively high procyclicality.

Meanwhile, empirical evidence indicates that costs associated with adjusting employment (e.g. hiring, training and firing costs) are high in emerging-market economies.[17] To incorporate this labor institutional factor and to adjust for the high procyclicality, we embed a quadratic labor adjustment cost into the baseline model and explore the role of a dynamic labor demand. As shown in Eq. (10), with a positive τ, the wage is no longer simply the marginal product of labor in the current production. In fact, both the wage and the labor input display hump-shaped impulse responses to a productivity shock.

Column (d) presents the results when the quadratic adjustment cost parameter $\tau = 5$ matches the relative volatility of labor to output in the data. Now output volatility is reduced from 2.28% to 2.02% because the adjustment cost essentially smooths the labor adjustment rate and the labor input is only adjusted gradually. This increases the persistence of output fluctuations while reducing its volatility. The model with labor adjustment cost brings the correlation between wage and output and the correlation between labor and output closer to the data as the introduced labor market frictions make wage and labor less responsive to the concurrent shocks. However, this improvement is not significant quantitatively, and it is introduced at the cost of reducing the wage volatility relative to output. Compared to the labor input, the wage in this case is much more responsive ($\sigma(w)/\sigma(l) = 3$ as opposed to $\sigma(w)/\sigma(l) = 2.1$ in the baseline model).

4.3.3. *Different shock processes*

First, we consider alternative scenarios in which only productivity shocks or only interest rate shocks are prevalent to isolate the role of countercyclical interest rate shocks. Comparing column (e) and column (f), it is evident that countercyclical interest rates contribute the most to generating high variations in the labor market variables, as well as in consumption, while productivity shocks contribute most to the absolute output volatility. This is because the interest rate directly affects the intertemporal consumption-saving decision and the cost of working capital borrowing, which pays for the labor compensation, while productivity direct affects output production process.

Second, when we shut down the interaction between interest rate shocks and productivity shocks (i.e. $\rho_{a,r} = 0$), column (g) shows that this would reduce the volatility of consumption and wage and most importantly, the model can no longer generate a countercyclical trade balance.

Lastly, we allow the country interest rate to be negatively related to fluctuations in the expected future productivity as in Eq. (15). Consistent with the findings in Neumeyer and Perri (2005), column (h) shows that feeding in the induced interest rate shocks improves the model's predictions on several dimensions: higher volatility of output and relative volatility of

[17] According to the OECD measure, Mexico has much stricter Employment Protection Legislation (EPL) than U.S. and Canada, although the most strict EPL is practiced in southern Europe (including Turkey), France and Germany.

wage and more negative correlation between trade balance and output. However, the excess correlation of wage with GDP (0.97) arises because, in this case, the financial cost of hiring labor is better synchronized with the productivity shock. Also note that the country interest rate is more negatively related to output when it is induced by fundamental economic conditions. This implies that other things equal, when the correlation of the interest rate and productivity increases in absolute terms (or become more negative), the wage becomes more volatile and trade balance become more countercyclical.

4.3.4. Sensitivity analysis

Previously we assume that 100% of the wage bill has to be paid in advance (i.e. $\theta = 1$). However, Mendoza and Yue (2008) argue that in the data, the ratio between total bank credit to the private sector and GDP in emerging markets, on average, is only 50% of GDP. With a labor share of 0.68, this implies that about 73% of the wage bill is financed by working capital. In this section, we consider $\theta = 0.73$. Column (i) of Table 3 shows that when the requirement on working capital financing is relaxed, the qualitative results remain, but both the wage and consumption become less volatile than before, and the trade balance is mildly countercyclical. Moreover, output is no longer as volatile, because the interest rate does not affect the cost of employing labor as much. Therefore, labor demand does not shift as much to interest rate shocks, leading to less changes in both wage and labor.

5. Concluding remarks

This paper documents novel facts that suggest cyclical wage movements in emerging markets follow strikingly 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. This paper then demonstrates that the observed difference in financial factors, especially the countercyclical interest rates in emerging markets, can help to explain the differences. In a small open economy model where interest rate shocks directly affect the financial cost of employing labor through the working capital requirement, a countercyclical interest rate in emerging markets makes wage payments more expensive in economic downturn and less so in booms and generates a relatively large income effect on labor supply due to the intertemporal substitution. This leads to a relatively weak labor response and a strong wage response in emerging economies.

The analysis emphasizes the role of countercyclical interest rates in wage fluctuations. Given the evidence shown in the paper, it is not only plausible but also relevant. 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 unions, unemployment insurance, minimum wages, labor mobility, etc.) can serve as alternative explanations of the differential wage movements between these two country groups.[18] In this paper, we take a shortcut to capture the roles of other factors, such as labor market conditions and institutional factors, by allowing for a quadratic labor adjustment cost. The results suggest that although it contributes to break the tight connection between wage and labor productivity, the labor adjustment cost does not necessarily bring the model's predictions on wage volatility closer to the data. To study labor market frictions carefully, one probably needs to investigate this issue in a different framework, for example, one that allows for Mortensen–Pissarides type of search-matching frictions (see Boz et al., 2009).

In addition, the empirical evidence in the paper is based on aggregate wage data and has its limitations, as mentioned in the paper. Future research using microeconomic evidence or individual wage data would be certainly helpful in understanding the wage formation.

Appendix A. Business cycle data on Mexico

The data reported in Table 3 comes from the 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). The Solow residual is defined as $\ln A_t = \ln(y_t) - \alpha \ln(k_t) - (1-\alpha)\ln n_t$. The capital share ($\alpha$) is set to be 0.32 as in the calibration section. The employment data is taken from Neumeyer and Perri (2005) and is extended to 2005:4 by using general employment series data from the ILO periodical dataset. To calculate total hours worked, we 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 by taking the product of total employment data from OECD and the derived average hours per worker.

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 Dhareshwar (1993), which derived capital stock series for 92 countries using a modified Harberger approach. The initial capital stock is then accumulated afterwards by using the "gross fixed capital formation" series from OECD as investment.

[18] 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 are actually heavily unionized. However, the data on labor market institutions is especially scarce for developing countries.

Appendix B. Evidence using annual data

	Output	Real wage				Output	Real wage		
	$\sigma(y)$	$\sigma(w)$	$\frac{\sigma(w)}{\sigma(y)}$	$\rho(w,y)$		$\sigma(y)$	$\sigma(w)$	$\frac{\sigma(w)}{\sigma(y)}$	$\rho(w,y)$
Emerging economies					Developed economies				
Argentina	2.96	7.18	2.43	0.13	Australia	1.20	1.67	1.39	0.24
Brazil	0.85	1.67	1.96	−0.10	Austria	0.89	0.62	0.69	0.21
Chile	3.16	3.83	1.21	0.32	Belgium	1.00	0.79	0.79	0.12
Czech Republic	1.87	1.98	1.06	0.19	Canada	1.35	0.99	0.73	−0.22
Ecuador	1.62	6.27	3.87	0.36	Denmark	1.14	1.21	1.06	0.14
Hong Kong*	2.32	1.93	0.83	0.16	France	0.76	0.98	1.28	0.40
Israel*	1.38	3.35	2.43	0.18	Germany	1.53	0.93	0.61	0.11
Korea*	2.31	3.78	1.64	0.48	Italy	0.85	0.89	1.04	−0.06
Mexico*	2.39	5.12	2.14	0.43	Japan	0.99	0.81	0.82	0.38
Philippines	2.68	5.57	2.08	0.36	Netherlands	1.81	1.17	0.65	−0.13
Russia	5.81	8.01	1.38	0.85	Norway	1.12	1.38	1.23	0.44
Singapore*	2.16	3.45	1.60	0.46	Sweden	1.12	1.96	1.75	0.39
Slovak Republic	0.87	2.56	2.94	0.73	Switzerland	1.09	0.53	0.49	−0.20
Taiwan*	1.39	1.39	1.00	−0.05	United Kingdom	1.19	1.33	1.11	0.02
Turkey	3.75	6.06	1.62	0.54	United States	1.26	0.98	0.77	0.13
Average (BLS)	1.99	3.17	1.61	0.28	Average	1.19	1.08	0.96	0.13
Average	2.37	4.14	1.88	0.34	*t*-statistics	3.66	5.52	4.03	2.32

Notes: The variables are annual for the period 1975–2004. The series are logged first and then filtered using the 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 C for detailed data sources. *t*-statistics reported in the last row are obtained by running the mean comparison test across the emerging economies and the developed economies.

Appendix C. Data sources

	Quarterly						Annual	
	Period	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		ILO	ILO	IFS	1975–2000	UNIDO
Czech Republic	1995.1–2005.4	IFS		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	ILO	EIU	1975–2004	BLS
Israel	1989.1–2005.4	IFS		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	NP	IFS	–	EIU	1975–1997	UNIDO
Russia	1993.1–2005.4	OECD	EMBI+	OECD	–	OECD	1993–1998	UNIDO
Singapore	1993.1–2005.4	IFS		EIU	ILO	EIU	1975–2004	BLS
Slovak Republic	1991.1–2005.4	OECD		OECD	OECD	OECD	1993–2003	IFS
Taiwan	1993.1–2005.4	OECD		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
United Kingdom	1985.1–2005.4	OECD	OECD	OECD	OECD	IFS	1975–2004	BLS
United States	1985.1–2005.4	OECD	OECD	–	OECD	IFS	1975–2004	BLS

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

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