Essays on Labour Market Fluctuations in Emerging Markets

by

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Abstract

The goal of this dissertation is to compare and contrast labour market fluctuations in emerging and developed markets, and to explore the sources of differences in these fluctuations across country groups. Chapter 2 documents cyclical properties of labour share over the cycle for various countries and show that there is a close relationship between labour share and the cost of borrowing. Labour share tends to be more volatile and procyclical with output especially in countries with highly volatile and countercyclical interest rates. The results are driven neither by sectoral shifts over the cycle nor by the measurement errors in the labour compensation data. In Chapter 3, we show that working capital requirements can predict the right sign of the labour share comovement with output and can partly account for the volatility of the labour share. It is also shown that imperfect financial markets in the form of credit restrictions not only amplify the results for the variability of labour share but also helps better explain some of the striking business cycle regularities in emerging markets, such as highly volatile consumption, strongly procyclical investment and consumption, and countercyclical net exports.

Fluctuations in real wages are mostly responsible for the highly volatile labour share in emerging markets. Previous literature showed that search frictions with countercyclical interest rates can explain movements in wages in these economies. Chapter 4 shows that when agents are allowed to choose the amount of hours worked (intensive margin of the labour input), the effects of search frictions on wages are mitigated. Our motivation of introducing intensive margin comes from the fact that variations in hours per worker are at least as significant as those in the employment in emerging

markets. They are also more cyclical with output in these economies than in developed ones. Search frictions fail to explain these cyclical properties of the intensive margin. On the other hand, by introducing financial frictions, the model can predict them together with movements in real wages. This suggests that frictions in both labour and financial markets go further in explaining emerging market business cycles.

Preface

Chapter 4 of this dissertation, titled "Search Frictions, Financial Frictions, and Labour Market Fluctuations in Emerging Markets", is a manuscript co-authored with Sumru G. Altug. The identification and design of the research program for this paper were carried out by Serdar Kabaca, with comments by Sumru G. Altug. Background research, the data analysis, and the preparation of the manuscript were performed jointly. All other chapters of the dissertation is accomplished solely by Serdar Kabaca.

"Search Frictions, Financial Frictions, and Labour Market Fluctuations in Emerging Markets" Altug and Kabaca (2013), has been submitted for publication.

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Dedication

To my parents Ayten and Oğuz Kabaca.

None of this would have been possible without their love and sacrifices.

Chapter 1

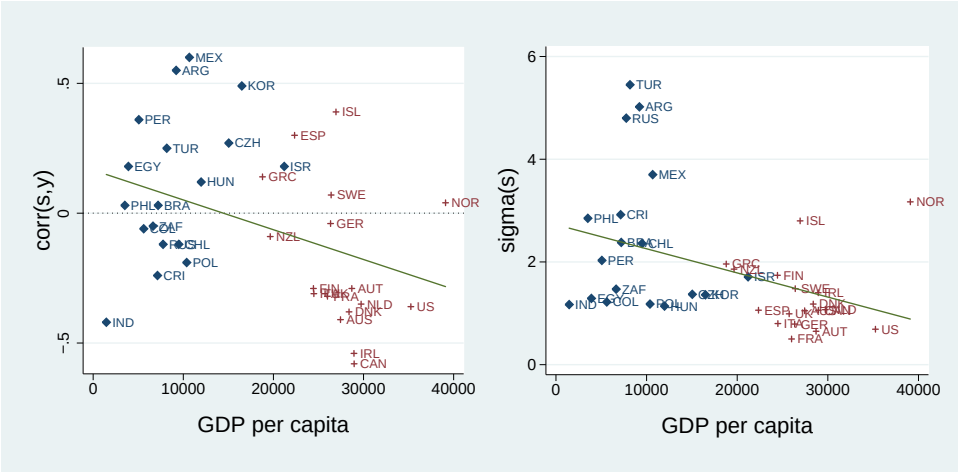
Introduction

Labour markets in emerging markets (EMs) are characterized by highly volatile and procyclical real wages in the literature. Real wages in EMs are almost twice as volatile as in developed markets (DMs). Additionally, they are more procyclical with output in EMs than in DMs. This dissertation shows that the high volatility in real wages in these economies are not off-set by small variations in labour input. Thus, total labour income as well tends to be more volatile than output in EMs. This is in contrast to developed markets, where labour markets tend to be more sluggish and lag behind output. Our measure of labour market responsiveness is the cyclical property of labour share over the cycle.

Figure 1.1 illustrates the characteristics of labour share fluctuations in both emerging and developed markets, the details of which are studied in Chapter 2. Labour share tends to be procyclical with output on average in emerging markets whereas it is slightly countercyclical in developed markets. In addition, labour share is much more volatile in low income countries than in developed markets.[1] However, there is a large variation across countries in terms of characteristics of labour share fluctuations. India, for instance, having the lowest income per capita in our sample does not show a procyclical labour share. Yet Korea has a strongly procyclical one although it is one of the richest emerging economies. Figure 1.2, on the other hand, gives us a more clear picture. It shows that labour share is procyclical with output especially in the countries with countercyclical interest rates, i.e., a decrease in the cost of borrowing during booms tends to increase labour share. The

[1] Despite small variations and weak cyclicality in the labour share of developed markets, there is a declining trend in recent years in these economies. This dissertation studies the different business cycle movements of this variable across country groups, rather than changes in the trend.

Figure 1.1: Labour Share Fluctuations across Income Level

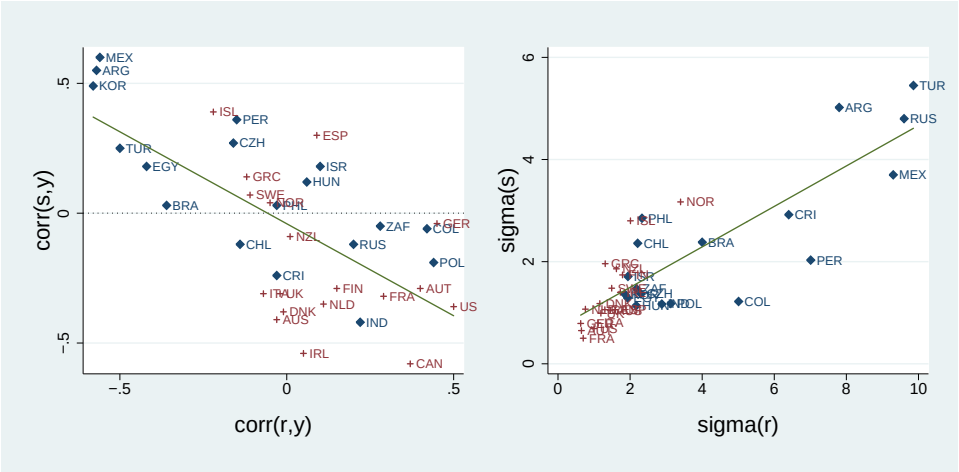


Note: corr(s,y) and sigma(s) denote the correlation of labour share with output and the standard deviation of labour share, respectively. The variables are detrended and logged. Labour share is annual and covers the period after 1980 for most countries. GDP per capita (PPP adjusted in US dollars) in 2000 is taken for the income level. See the Appendix A for data sources.

more countercyclical interest rates are, the more procyclical labour share is. Moreover, the countries that face more volatile interest rate tend to have more volatile labour share, as well. We also show below that negative slope coefficients in Figure 1.1 disappear when we take fluctuations in the interest rate into account. Finally, these results are robust to adjustments of the labour share that controls self-employment and the informal sector.

After discussing the volatility and the cyclicality of labour share in both EMs and DMs, we build a model in Chapter 3, where wages have to be financed through working capital loans, and show that the variation in the cost of borrowing can account for the movements of the labour share over the cycle. The premise of this dissertation is that financing matters to labour market fluctuations and that emerging markets serve as a good natural experiment due to the financial problems and the different features of the interest rate that they face. On the other hand, the contribution of these frictions might be smaller in developed markets as they face a more stable interest rate over the cycle.

Figure 1.2: Labour Share vs. Interest Rate Fluctuations



Note: corr(s,y) and sigma(s) denote the correlation of labour share with output and the standard deviation of labour share, respectively. The variables are detrended and logged. Labour share is annual and covers the period after 1980 for most countries. r denotes real annualized interest rates in those countries. See the Appendix A for data sources.

Chapter 4 reveals two more distinguishable features of labour market fluctuations in EMs. (1) The contribution of hours per worker to the movements of total labour input – total hours – are higher in EMs than in DMs. (2) Hours per worker is procyclical with output and positively correlated with employment in EMs, while they are less cyclical with output and not correlated with employment in DMs. This chapter attempts to answer these differences through the behaviour of interest rate in EMs in an environment with search and financial frictions.

Chapter 2

The Empirics of Labour Share Fluctuations in Emerging Market Economies

2.1 Introduction

One of the stylized facts of growth in Kaldor (1961) is that factor income shares are stable over time.[2] This fact has justified many economic models using constant income shares. Unlike its stability over the long run, though, business cycle literature has shown that labour (income) share has short-term dynamics moving slightly against output in major economies. However, the literature has focused on developed markets (DMs), mostly on the US, and is silent on labour share fluctuations in emerging markets (EMs).

In this chapter, we document the volatility and the cyclicality of labour share in emerging markets and compare them to ones in developed markets. The contribution of this chapter is threefold. First, it shows that the cyclical properties of labour share in EMs, on average, significantly differ from those in DMs. Second, the behaviour of interest rate and financing conditions over the cycle account more for these differences than the lower income level in these economies. Therefore, we will claim that there is a close relationship between labour share and the interest rate that these economies face in international markets. This chapter also provides more evidence supporting this claim from both the emerging and developed world, along

[2] Recetly, there has been a declining trend in labour share in many advanced economies, particularly the US.

with robustness checks for different definitions of labour share. we will then, in Chapter 3, build a model where wages have to be financed through working capital loans and show that the variation in the cost of borrowing can account for the movements of the labour share over the cycle. The premise of this dissertation is that financing matters to labour share and that emerging markets serve as a good natural experiment due to the financial problems and the different features of the interest rate that they face.

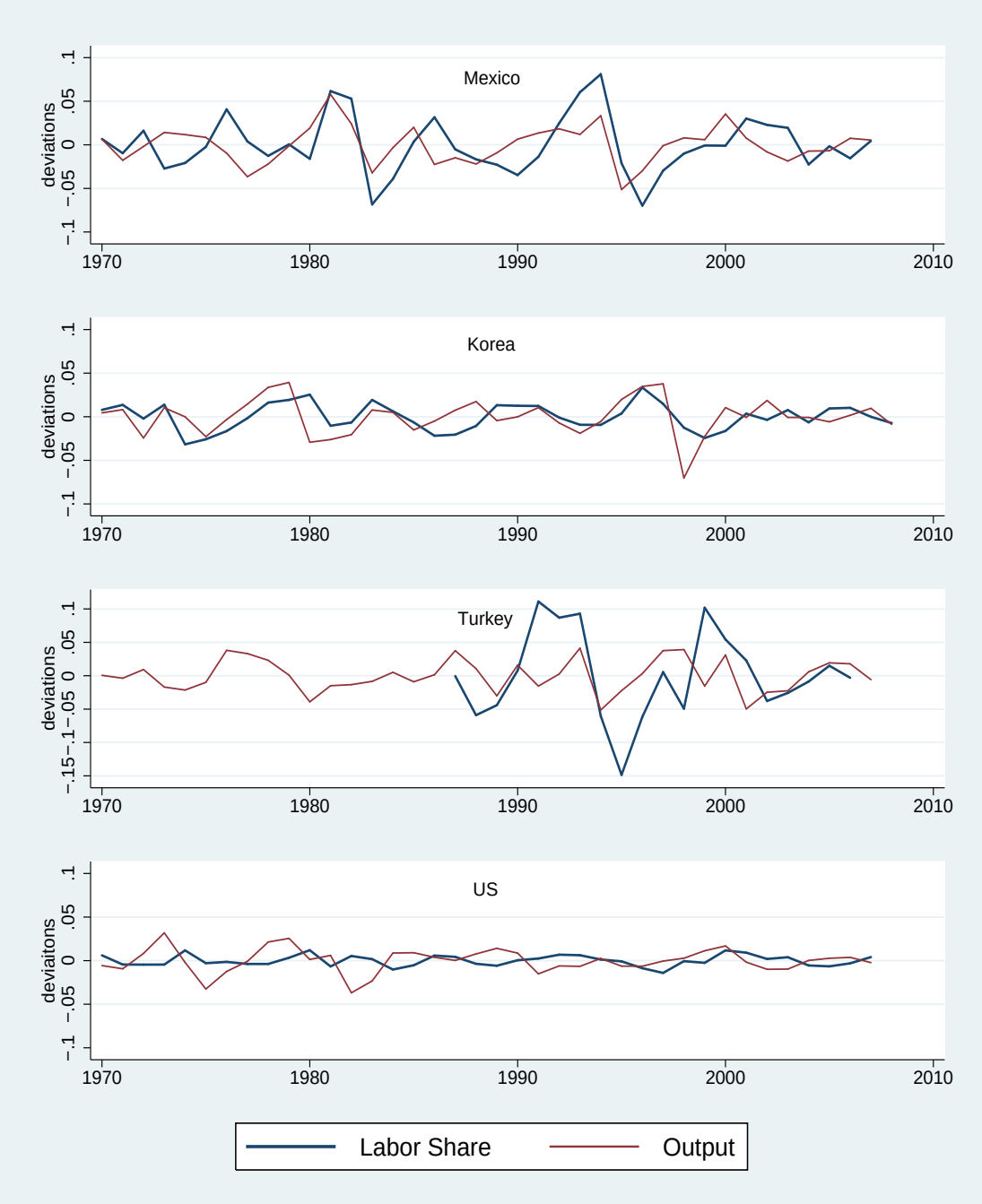
Figure 2.1 shows the annual movements of labour share (deviations from trend) over the cycle in selected emerging market economies such as Korea, Mexico, and Turkey. For comparison, we include the cyclical properties of labour share in the US, as well. There are significant variations for the cyclical component of labour share over the cycle in these selected EMs. More importantly, these variations are systematic; they move positively with output. Labour share rises during boom times, and it falls during output contractions. In contrast, the variations are much smaller in a developed market, such as the US, and they tend to move in the opposite direction to output.[3]

We document labour share fluctuations for other developing countries as well. In Section 2.2, we first state our definition of labour share and calculate it across countries and over time using data on compensation of employees from official accounts compatible with the 1993 System of National Accounts (SNA). These observations are plotted in Figure 1.1, which illustrates that labour share tends, on average, to be procyclical with output in emerging markets. On the contrary, it is slightly countercyclical in developed markets. In addition, labour share is much more volatile in low income countries. Despite these average cyclical properties of labor share in EMs, there is a large variation across countries.[4] India, for instance, having the lowest income per capita in our sample, does not show a procyclical labour share. Yet Korea has a strongly procyclical one although it is one of the richest

[3]The correlation coefficient for the US is -0.36, whereas these coefficients are 0.52, 0.55, and 0.25 for Korea, Mexico, and Turkey.

[4]Gollin (2002) shows that, after adjustments, the *level* of labour share across countries does not depend on income level. Here, we show that the *volatility* of labour share does not necessarily depend on it either.

Figure 2.1: Labour Share Fluctuations in Mexico, Korea, Turkey and the US



Note: The variables are detrended using the HP-filter. The y-axis shows percentage deviations from the trend.

emerging economies.

Figure 1.2, on the other hand, gives us a more clear picture. It shows that labour share is procyclical with output, especially in the countries with countercyclical interest rates, i.e., a decrease in the cost of borrowing during booms tends to increase labour share. The more countercyclical interest rates are, the more procyclical labour share is. Additionally, the countries that face a more volatile interest rate tend to have a more volatile labour share, as well. We also show below that the negative slope coefficients in Figure 1.1 disappear when we take fluctuations in the interest rate into account. These results are proven robust to different measures of and adjustments on labour share.

In Section 2.2, we provide more evidence using quarterly data. In doing so, we are also interested in the lead-lag relationship; labour share is shown to lag behind output in emerging economies. This is perhaps due to the sluggishness in labour markets addressed in the literature, which we will describe below. In this section, we also document the volatility statistics of the components of labour share, namely wages and employment. We show that the high volatility of labour share is mainly driven by highly volatile (real) wages. But, importantly, this comes not at the expense of low volatility of employment; labour input is still nearly as volatile as output in many EMs.

Despite the limited data availability for recent years, we discuss the cyclical component of labour share in the 2008-2009 global financial crisis. We show that labour share did not significantly change in the recent financial crisis although capital flew out of EMs and output collapsed. However, we also show that the real cost of borrowing for these economies did not change, either. In other words, interest rates were not countercyclical during 2008-2009 in these economies despite the capital flight. On the other hand, countries such as, Greece, Spain, and Iceland, that saw increases in the cost of borrowing, tend to have a declining labour share. Therefore, our results from emerging markets above have the potential to shed some lights on the debt-troubled European economies.

We perform robustness analyses on labour share measures in Section 2.3.

Firstly, we adjust labour share by including the labour portion of the self-employment income, which does not change the main empirical findings. Secondly, we discuss if the lack of labour income data from the informal sector in EMs could be a reason for the procyclical share. We show that large informal employment does not necessarily associate with more procyclical labour share. Moreover, when labour income in the informal sector is taken into account using official data on labour income in Mexico, the variations become even more apparent and more procyclical. Thirdly, we show that sectoral shifts cannot be a reason for the movements in labour share since contributions of these sectors to the value added are not significantly cyclical with output. Lastly, the results on labour share are shown to hold even when we exclude the public sector. Thus, a procyclical government sector cannot explain the procyclicality of labour share in EMs.

Movements in labour share in developed economies have already been addressed in the literature. The countercyclicality of labour share is well-know in the US (see Kydland and Prescott (1982), Gomme and Greenwood (1995), Boldrin and Horvath (1995), and Rotemberg and Woodford (1999), among others). In addition, Gomme and Greenwood (1995) and Giammarioli et al. (2002) find similar patterns for labour share in other OECD countries. There are many labour-market related explanations for this behaviour of labour share.[5] Gomme and Greenwood (1995), Boldrin and Horvath (1995), and Danthine et al. (2005) include an insurance component in the wage that makes total labour income less sensitive to output and, therefore, generates countercyclical labour share. Adjustment costs, such as hiring and firing costs and/or vacancy costs as in search models, have the potential to explain the sluggish labour market and countercyclical labour share. Andolfatto (1996), Merz (1995), and Ríos-Rull and Choi (2009) can generate this behaviour of labour share in the US using search theory. In a modified version of the firing-cost model of Bentolila and Bertola (1990), Vermeulen (2007) shows that adjustment costs, such as firing costs, can explain an important part of the variation in labour share in France. In an empirical work, Bentolila and Saint-Paul (1998) find that adjustment costs,

[5] These mechanisms will be further explained in Chapter 3.

which result in a gap between marginal product of labour and real wage, have a significant explanatory power for the movements of labour share, along with shifts in the capital-output ratio as a result of the price of oil or capital-augmenting technological progress. Another strand of literature uses capacity constraints (see Hansen and Prescott (2005)) or a framework with monopolistic competition and mark-ups (see Hornstein (1993) and Ambler and Cardia (1998)).

To our knowledge, Diwan (2002) is the only work that discusses labour share movements in developing countries, albeit not over the business cycle. He concentrates on financial crises in developing economies and shows that labour share tends to decline during these crises. He then discusses potential reasons behind this decline, and emphasizes the relative immobility of labour. Maarek and Orgiazzi (2010) take a similar stance and show that low bargaining power stemming from capital flights can explain the decline of the labour share following financial crises. However the bargaining power argument cannot explain recent increase in the US labour share and/or in emerging markets after the 2008 financial crisis. The difference in this paper is that first, we not only consider the crisis period but also extend the sample to expansions and mild recessions. Second, our analysis that shows a strong relationship between interest rates and labour share in both emerging and developed markets is also novel. Third, the model we present in Chapter 3 is consistent with observations not only during the past crises but also during the 2008-2009 global financial crisis.

In Section 2.4, we discuss the financial environment in emerging markets and summarize the literature on EM business cycles related to financial linkages. Emerging markets, indeed, have large capital inflows during boom times and difficulties (limits) in financing during economic downturns. They also face high interest rates during recessions due to default risk. Therefore, during recessions, borrowing is costly not only in that it is limited but also that it requires high pay-back. We will show in Chapter 3 that when labour is financed through borrowing, these hikes in the effective cost of borrowing drive the labour share down.

2.2 Stylized Facts on the Fluctuations of Labour Share

2.2.1 The Measure of Labour Share

Labour share is computed using the total compensation of employees from GDP income accounts. In the income approach, gross value-added GDP is the sum of labour compensation, capital income (corporate profits, interest income, rental income and depreciation), mixed income of the self-employed (unincorporated income) and indirect taxes excluding subsidies. Most countries officially announce the total compensation of employees and indirect taxes net of subsidies. Using this information, we measure labour share as follows:

$$\text{Labour Share} = \frac{\text{Labour Compensation}}{\text{GDP-net indirect taxes}} \tag{2.1}$$

Since we are interested in the incomes earned by the factors of production, we exclude government income from gross value-added. In doing so, we assume that net indirect taxes go to both capital and labour income.

The above-mentioned formula is the widely-used measure for labour share in macroeconomics. However, data on labour compensation of employees suffer from measurement problems, particularly because they do not include labour income of the self-employed or of workers in the informal sector. Gollin (2002), for instance, shows that the absence of self-employment is partly responsible for significantly lower shares of labour income in developing countries due to the high fraction of self-employment in total employment in these countries.[6] Ignoring self-employment in labour cost will only mislead in terms of the cyclical component of labour share if self-employment is cyclical with output over the cycle. Below, we show that self-employment does not have any systematic comovement with output even though total employment is highly procyclical. In addition, Section 2.3 corrects labour share using approaches following Gollin (2002) and shows that the results remain unchanged. In that section, we also take into account informal sector, and conclude that these measurement errors do not play a role in our

[6] The ratio of self-employment goes up to 30% in many low-income countries.

results.

2.2.2 Data

We choose countries that report income accounts compiled with the 1993 System of National Accounts. Income accounts data have annual frequency and come from the OECD and the UN.[7] We include countries that have at least 10 annual observations to make sure that each country has recessions and expansions over the sample period. This leaves us with 18 emerging market economies. These economies cover most of the countries defined as emerging markets by institutions providing investment analysis.[8] [9] In addition to emerging markets, 18 developed markets are included in the sample for comparison. These countries are listed in Appendix A. Data for most of the emerging markets start in the 1980s. We take labour share data for developed countries after 1980 as well. For self-employment adjustment, we use ratios of self-employment from either the OECD or ILO statistics. The details on data sources can also be found in Appendix A.

As for real interest rates, Uribe and Yue (2006) have a dataset on quarterly interest rates (annualized) for emerging markets. They construct interest rates for each country using their corresponding JP-Morgan EMBI+ spread over US T-bills. Since these bonds are denominated by the US dollar, real yields are calculated using a proxy for the expected inflation in the US, which is equal to the average of the current and three preceding periods of annual inflation in the US, based on the GDP deflator.[10] One drawback of using these interest rates is the limited coverage over our sample period. For most countries, EMBI data start at 1994Q1 or 1999Q3, which gives us

[7] The OECD has longer labour compensation data for some developed countries, Mexico, and Turkey. We check that data in the OECD is consistent with data reported to the UN such that results are relatively fixed. Therefore, we choose the longer dataset from the OECD to do individual country analysis over time for these countries as well.

[8] Korea has been recently classified as a developed market in these institutions. However, during our sample period, 1980-2008, the country was mostly in the category of emerging markets, in that the GDP per capita in Korea was below $20,000 until 2004.

[9] We also include Costa Rica, given its relatively high per capita income and long time-series data, although it is not listed as an emerging market in FTSE or MSCI lists.

[10] Using future inflation as expected inflation does not change the results very much since inflation is more or less stable in the US over this period.

a small number of observations at an annual level. Another drawback is that these rates are the cost of borrowing in US dollars. Firms with local currency-denominated assets in their balance sheet would face an extra cost because of exchange rate movements. In addition, a varying intermediary cost (to access the international credit market) over the cycle might make financing more difficult, too. For these reasons, we mainly use domestic interest rates, as the dataset is longer and more representative of borrowing costs that firms face. Domestic rates come from IFS and represent the cost of financing short-term needs of the private sector.[11] The GDP deflator is used to obtain the real interest rate for each economy. In Appendix A, we also re-plot the figures above with available EMBI rates from the Uribe and Yue (2006) dataset, in order to check the sensitivity of the results to different measures of interest rates in emerging markets. For developed economies, interest rates come from OECD financial indicators. These are domestic short-term (treasury bill) interest rates on bonds that are denominated in local currency. As in the case of emerging markets, these rates are assumed to be representative cost of borrowing that an economic agent faces in these economies. Details by country can be found in Appendix A.

2.2.3 Observations

We document the statistics of annual labour share fluctuations in Tables 2.1 and 2.2 for emerging and developed markets, respectively. HP filtering is used to detrend the data together with a smoothing parameter of 6.25. We also add p-values for correlation coefficients in parentheses.

Volatile Labour Share. These statistics show that labour share, on average, is almost twice more volatile in emerging markets than in developed markets. Although the standard deviation over time is higher in emerging markets, there is also large variation in terms of this statistic within emerging economies. The median of standard deviation of the labour share is 2.05

[11] Either lending or treasury bill rates are used, depending on availability. If neither is available, money market or deposit rates are used. We confirm that all types of interest rate series move together within a country.

Table 2.1: The Cyclical Properties of Labour Share in Emerging Markets

	σ(s)	ρ(s,y)	σ(r)	ρ(r,y)	ρ(r,s)
Argentina	5.02	0.56	7.8	-0.57	-0.57
		(0.03)		(0.03)	(0.03)
Brazil	2.38	0.03	4.08	-0.36	-0.08
		(0.92)		(0.22)	(0.39)
Chile	2.36	-0.12	4.67	-0.02	0.19
		(0.54)		(0.89)	(0.32)
Colombia	1.22	-0.06	5.21	0.42	-0.25
		(0.88)		(0.02)	(0.36)
Costa Rica	2.92	-0.22	4.53	-0.03	-0.05
		(0.26)		(0.88)	(0.82)
Czech Rep.	1.37	0.27	2.30	-0.16	0.03
		(0.30)		(0.55)	(0.92)
Egypt	1.29	0.18	1.93	-0.40	-0.60
		(0.58)		(0.27)	(0.02)
Hungary	1.14	0.12	2.17	0.06	-0.11
		(0.67)		(0.83)	(0.71)
India	1.17	-0.44	2.89	0.22	-0.52
		(0.04)		(0.33)	(0.01)
Israel	1.71	0.17	1.94	0.10	-0.31
		(0.57)		(0.74)	(0.31)
Korea	1.36	0.45	1.83	-0.57	-0.20
		(0.02)		(0.01)	(0.31)
Mexico	3.72	0.60	9.10	-0.56	-0.66
		(0.0)		(0.0)	(0.0)
Peru	2.03	0.36	7.01	-0.16	0.02
		(0.07)		(0.52)	(0.92)
Philippines	2.85	0.02	2.33	-0.03	-0.09
		(0.95)		(0.92)	(0.74)
Poland	1.97	-0.19	3.45	0.44	-0.35
		(0.46)		(0.08)	(0.17)
Russia	4.8	-0.12	3.22	0.20	-0.70
		(0.68)		(0.49)	(0.02)
South Africa	1.47	-0.06	2.18	0.16	0.11
		(0.76)		(0.41)	(0.59)
Turkey	5.45	0.25	9.66	-0.49	-0.24
		(0.30)		(0.02)	(0.31)
Mean	**2.45**	**0.11**	**4.27**	**-0.10**	**-0.24**
Mean*	**2.78**	**0.34**	**5.49**	**-0.41**	**-0.29**

Note: P-values are in parenthesis. The symbols σ and ρ denote standard deviation and correlation. Mean* represents the average for countries facing countercyclical interest rates: Argentina, Brazil, Czech Republic, Egypt, Korea, Mexico, Peru and Turkey. Interest rates are net annual domestic rates from the IFS. See Appendix A for data sources.

Table 2.2: The Cyclical Properties of Labour Share in Developed Markets

	σ(s)	ρ(s,y)	σ(r)	ρ(r,y)	ρ(r,s)
Australia	1.05	-0.41	1.45	-0.03	0.62
		(0.02)		(0.50)	(0.0)
Austria	0.65	-0.29	0.65	0.40	-0.06
		(0.08)		(0.08)	(0.80)
Canada	1.06	-0.58	1.30	0.37	-0.22
		(0.0)		(0.06)	(0.26)
Denmark	1.18	-0.38	1.16	-0.03	-0.05
		(0.05)		(0.0)	(0.81)
Finland	1.74	-0.29	1.79	0.15	0.32
		(0.13)		(0.49)	(0.14)
France	0.50	-0.32	0.70	0.29	0.13
		(0.09)		(0.13)	(0.50)
Germany	0.79	-0.04	0.63	0.45	0.09
		(0.88)		(0.01)	(0.64)
Greece	1.96	0.14	1.31	-0.12	-0.23
		(0.49)		(0.54)	(0.64)
Iceland	2.8	0.39	2.01	-0.22	-0.03
		(0.03)		(0.0)	(0.89)
Ireland	1.4	-0.54	1.73	0.05	-0.06
		(0.01)		(0.87)	(0.75)
Italy	0.8	-0.31	1.11	-0.07	0.23
		(0.10)		(0.72)	(0.25)
Netherlands	1.07	-0.35	0.76	0.11	-0.01
		(0.10)		(0.63)	(0.97)
New Zealand	1.86	-0.09	1.62	0.01	0.53
		(0.65)		(0.95)	(0.01)
Norway	3.17	0.04	3.4	-0.05	-0.44
		(0.82)		(0.81)	(0.02)
Spain	1.06	0.30	1.59	0.09	0.34
		(0.13)		(0.63)	(0.08)
Sweden	1.48	0.07	1.49	-0.12	0.21
		(0.70)		(0.56)	(0.30)
UK	0.99	-0.31	1.19	-0.02	0.25
		(0.10)		(0.83)	(0.18)
US	0.69	-0.36	1.00	0.50	-0.42
		(0.05)		(0.01)	(0.03)
Mean	**1.34**	**-0.19**	**1.38**	**0.10**	**0.07**

Note: P-values are shown in parenthesis. The symbols σ and ρ denote standard deviation and correlation, respectively. Interest rates are the annual average of short-term interest rates on local denominated treasury bills over the period taken for labour share. See Appendix A for details on data.

versus the mean of 2.48.

One notable fact here is that the mean is significantly higher in countries facing high interest rate volatility, such as Argentina, Brazil, Mexico, Peru, Russia, and Turkey. Statistically, countries with higher volatility in their interest rates tend to have higher volatility in their labour share, as well. We divide the emerging market sample into two groups depending on whether they have lower or higher volatility in interest rates than the median[12]. The means of standard deviations of labour share for these two groups are: 1.62 versus 3.28, the higher being for the second group. The sample mean test rejects the equality of labour share volatilities across these two groups at a 2% significant level.

Procyclical Labour Share. In addition to higher volatility, comovement of labour share with output differs in emerging markets compared to developed ones. The correlation between the cyclical component of labour share and output tends to be procyclical (0.10) in emerging markets, whereas it is negative (-0.19) in developed markets. Since there is variation among countries in each group, we apply a sample mean test where the null hypothesis is that there is no difference in these correlations across different country groups. T-statistic from the mean test is 3.08, which falls in the region of rejection for the significance level of 1%. This indicates that labour share fluctuations are, indeed, statistically different in emerging economies than in developed ones.

Furthermore, it can be seen in Table 2.1 that average procyclical labour share is mostly driven by countries with countercyclical interest rates. Figure 1.2 also suggests that procyclicality of labour share becomes more apparent as the country faces more countercyclical interest rates. In a statistical analysis, we take Argentina, Brazil, Czech Republic, Egypt, Korea, Mexico, Peru and Turkey as countries having a countercyclical cost of borrowing.[13] Then, the average correlation of labour share with output goes up to 0.34,

[12]The median for the standard deviation of interest rate is 3.005

[13]When EMBI rates are considered, interest rates still show countercyclicality with output in these countries.

which implies a stronger procyclical labour share in those countries than the average in emerging markets. In Appendix A, we redo this exercise with interest rates constructed by EMBI spreads and show that the results are not sensitive to measures of interest rates.

Other countries in the emerging-market group do not have significantly different movements in labour share than in developed markets. T-stat and p-value from a sample-mean test between these countries and developed economies are equal to 1.36 and 0.19, respectively. This indicates that when interest rate variations are taken into account in those emerging economies, movements in labour share are not statistically different from those in developed economies.

Among developed markets, Table 2.2 shows that many countries exhibit procyclical real interest rates. Possible explanations for procyclical rates are accommodative monetary policy during recessions, i.e., countercyclical policies (see King and Watson (1996)) and cyclical marginal productivity of capital following a productivity shock (see Kydland and Prescott (1982). On the other hand, developed markets such as Greece, Iceland and Sweden are likely to face countercyclical rates.[14] These are also countries that tend to have a labour share moving more positively with output than the rest of the developed group. Therefore, similar pattern appears in advanced economies, albeit not frequently.[15]

Quarterly Evidence. We also document quarterly fluctuations of labour share on which we have data for only Brazil, Korea, Mexico and Turkey. For comparison, we add the results from the US as well. Table 2.3 presents these results and the starting date for the sample countries. We confirm that the results are similar to those from annual data. One interesting point to mention is that the labour share seems to lag behind output in all four countries. This is perhaps because of a sluggish response of labour markets

[14] For these countries, the correlation between real interest rates and output is below -0.10.

[15] We also discuss below the labour share movements during the recent debt crisis in some of the advanced economies such as Greece, Portugal and Spain.

to shocks in the economy through search and matching frictions, hiring and firing costs, and contractual agreements between firm and worker. In fact, the literature on labour share in developed economies models these frictions to explain the slightly negative correlation between labour share and output in these economies (See Boldrin and Horvath (1995), Bentolila and Saint-Paul (1998), and Ríos-Rull and Choi (2009) among others).

The above-mentioned labour frictions might be important in developing countries as well. For instance, the dataset from Botero et al. (2004) suggests that emerging economies' labour markets are not flexible: they lay between European and Anglo-Saxon countries in terms of employee protection laws.[16] However, a positive correlation between labour share and output implies that total labour income responds to economic shocks more than the output does. Therefore, those frictions will potentially have a lesser power to explain labour share movements in economies with procyclical labour share. This is why, in this dissertation, we try to explore other effects on labour share movements such as labour financing through working capital frictions and the ability to borrow for short-term needs, the details of which are discussed in the next chapter.

The Correlation between Labour Share and Interest Rate. We have so far discussed the link between labour share and interest rate movements with output, but not the direct correlation between labour share and interest rates. If there were a strong relationship, then we should also observe a non-zero correlation between these variables over the cycle.

Figure 2.2 shows the scatter plot of correlations between labour share and (real) interest rates for all the countries in the sample. We note that, on average, the correlation between labour share and interest rates is below zero. More importantly, in regions where interest rates are cyclical with output[17] – whether procyclical or countercyclical – labour share has a stronger negative correlation with interest rates. On the other hand, in countries

[16] We will discuss this in more detail in Chapter 4.

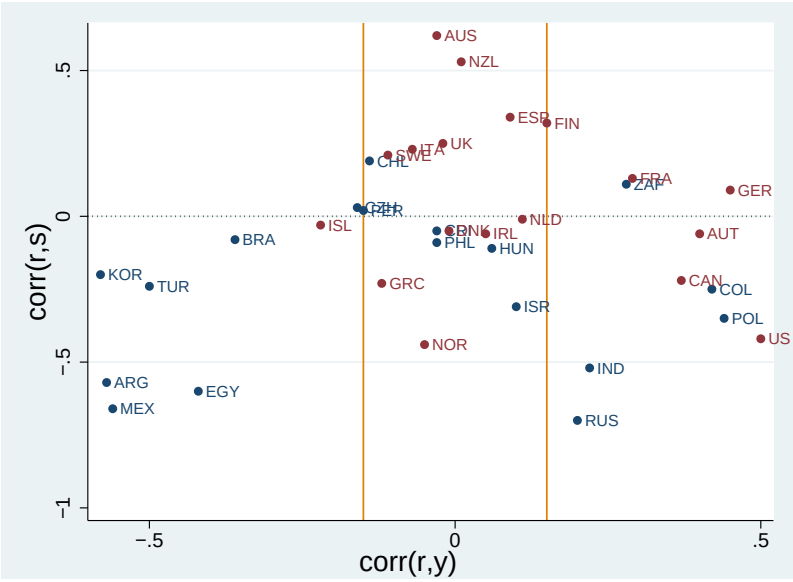
[17] We assume here that the (absolute) correlation between interest rates and output has to be at least 0.15 for interest rates to have a sufficient comovement with output.

Table 2.3: Evidence from Quarterly Data

	$\sigma(s)$	$\rho(s,y)$	$\rho(s_{+1},y)$	$\rho(s_{+2},y)$	$\rho(s_{+3},y)$	$\sigma(r)$	$\rho(r,y)$
Brazil.91Q1	4.3	0.09	0.14	0.13	0.16	2.9	-0.33
		(0.47)	(0.24)	(0.28)	(0.18)		(0.07)
Korea.89Q1	2.69	0.11	0.27	0.46	0.58	1.72	-0.72
		(0.39)	(0.02)	(0.01)	(0.01)		(0.0)
Mexico.87Q1	3.65	0.42	0.56	0.58	0.52	2.1	-0.54
		(0.01)	(0.0)	(0.0)	(0.0)		(0.01)
Turkey.87Q1	7.8	0.12	0.23	0.27	0.33	1.72	-0.45
		(0.39)	(0.04)	(0.02)	(0.01)		(0.0)
Mean	**4.61**	**0.19**	**0.30**	**0.36**	**0.40**	**2.33**	**-0.55**
US.80Q1	0.72	-0.34	-0.17	-0.11	-0.05	1.25	0.41
		(0.0)	(0.07)	(0.24)	(0.64)		(0.0)

The table shows the cyclical properties of labour share in quarterly frequency with current and lagged output. The correlation between interest rate and output is also presented for those countries in the sample. See Table 2.1 for the symbol denotation. The starting quarter of the sample for each country follows the country name. Sources: IPEADATA (national source) for Brazil, OECD for Korea and Mexico, and TURKSTAT (national source) for Turkey. See Appendix A for the sources of interest rates.

Figure 2.2: Correlation between Labour Share and Interest Rate



Note: corr(r,s) and corr(r,y) denote the correlation between labour share and (real) interest rates and between output and interest rates, respectively. All variables are in logs (except interest rates) and are detrended using the HP filter. The yellow line represents the benchmark correlation between interest rates and output, 0.15. See Appendix A for sources of these variables.

where interest rates are not cyclical with output, the cyclical properties of labour share vary dramatically. A model with wage bill financing, presented later in Chapter 3, is consistent with this fact observed in the data. Particularly, this model will be powerful to explain the movements of labour share in countries with considerable changes in interest rates over the business cycle, such as risky emerging market economies. In contrast, this effect will be small in countries with relatively stable and acyclical interest rates, as in many advanced economies.

Labour Share Components – Wages and Employment: Total labour income (or total labour compensation) in a country is, in the end, the multiplication of wages (compensation per employee) and total employment. A natural question to ask here is: how much this high volatility comes from each of those two components? Is it wages or the labour input that makes total labour income more responsive than output?

Table 2.4 and Table 2.5 document the cyclical properties of wages and employment, respectively.[18] First of all, real wages are more volatile than output for all developing countries, with the exception of Chile. In fact, on average, real wage is almost twice as volatile as output over the cycle in emerging economies. This result is quite different in developed markets, where wages are less volatile than output (see Krugman (1999), for example). Secondly, Table 2.5 suggests that employment is less volatile than output. Lastly, both wages and employment tend to be procyclical with output in emerging economies. These results show that the cyclical properties of labour share we discuss above is driven more by the movements in wages than those in employment.

Recently, Li (2011) and Boz et al. (2009) have also documented wage and employment regularities in some emerging markets and found similar empirical results. Our contribution here is to show that total labour income

[18]Total hours would be more relevant for the labour input. However, hours data are available only for a smaller set of countries with a shorter time horizon. Therefore, we choose to present employment movements here. With a shorter horizon, we will also analyze hours per worker and employment dynamics in Chapter 4.

in these economies tends to be more volatile than output, generating a procyclical labour share over the cycle. Thus, high volatility of real wages in these economies is hardly at the expense of low employment volatility. We show in Table 2.5 that some of the low volatility in employment is due to the high self-employment ratio that is weakly cyclical with output (see Section 2.3 for details on self-employment and its cyclical properties). In fact, when we only take into account the number of employees (wage earners), both volatility and comovement of labour input with output increase. Therefore, employment is responsive in these economies over the cycle, albeit not as volatile as real wages. To sum up, overall labour market is more volatile than output to shocks in the economy, and this *extra* volatility in the labour income is mostly attributable to the price component (real wages) rather than the quantity component (labour input).

Individual-Country Analyses. Mexico and Korea have long horizon data which allow us to examine changes in the cyclical properties of labour share over different decades. Figure 2.1 shows that in Mexico, where data on labour share go back to the 1970s, the volatility and procyclicality of labour share appear especially in the 1980s and 1990s. This period is accompanied by a highly unstable financial environment and highly volatile capital flows in and out of the country. The comovement of labour share and output disappears when the economy stabilizes after 2001; so does the relationship between interest rates and output. In addition, we do not observe the procyclical labour share in the 1970s, when financial liberalization had not yet occurred.

The results are similar in Korea, except that we do observe procyclical labour share in the 1970s as well as in other decades, but we verify that Korean (real) interest rates were already countercyclical with output in the 1970s, a phenomenon that started earlier than in Mexico. Another remarkable point in the figure is that labour share peaked just before the financial crises in all countries – the financial crises are Mexico (1995), Korea (1998), Turkey (1994 and 2001) – and saw a large drop during those crises. These anecdotal pieces from individual-country analyses also support the re-

Table 2.4: Labour Share Components – Cyclical Wages

	Obs	σ(y)	$\frac{\sigma(w)}{\sigma(y)}$	$\rho(w, y)$	$\frac{\sigma(w_{man})}{\sigma(y)}$	$\rho(w_{man}, y)$
Argentina	27	3.87			1.58	0.55
Brazil	18	1.87	2.87	0.54		
Chile	28	2.35	0.89	0.22		
Costa Rica	27	2.05	2.44	0.63		
Korea	28	2.06	1.2	0.7		
Mexico	28	2.1			1.99	0.49
Peru	28	4.14	2.39	0.42		
Philippines	28	2.50	1.16	0.44		
Turkey	28	2.55			2.61	0.39
Average		**2.61**	**1.82**	**0.50**	**2.06**	**0.48**

Note: Real wage applies to the overall economy. For countries such as Argentina, Mexico, and Turkey, we have real wage data for only manufacturing, represented as W_man here. Wages are total gross earnings per worker except for Argentina, Chile, and Turkey in which they are hourly earnings. The source for wages is ECLAC (Economic Commission for Latin America and the Caribbean) for Brazil, Chile, Costa Rica, and Mexico; ILO for the Philippines; and INEC and TURKSTAT (National sources) for Argentina and Turkey, respectively. The first column shows the number of annual observations we have over time, untill 2008.

Table 2.5: Labour Share Components – Cyclical Employment

	Obs	σ(y)	$\frac{\sigma(e)}{\sigma(y)}$	$\rho(e,y)$	Obs	$\frac{\sigma(ee)}{\sigma(y)}$	$\rho(e,y)$
Argentina	27	3.87	0.50	0.71	12	0.75	0.78
Brazil	27	1.87	1.02	0.49	27	1.18	0.53
Chile	26	2.35	0.98	0.42			
Costa Rica	24	2.05	1.10	-0.02	22	1.13	0.24
Korea	28	2.06	0.64	0.78	28	0.85	0.82
Mexico	28	2.10	0.41	0.62	16	0.50	0.61
Peru	28	4.14	0.38	0.44			
Philippines	28	2.50	0.51	0.14			
Turkey	28	2.55	0.65	-0.05	21	0.59	0.55
Average		**2.61**	**0.69**	**0.38**		**0.84**	**0.59**

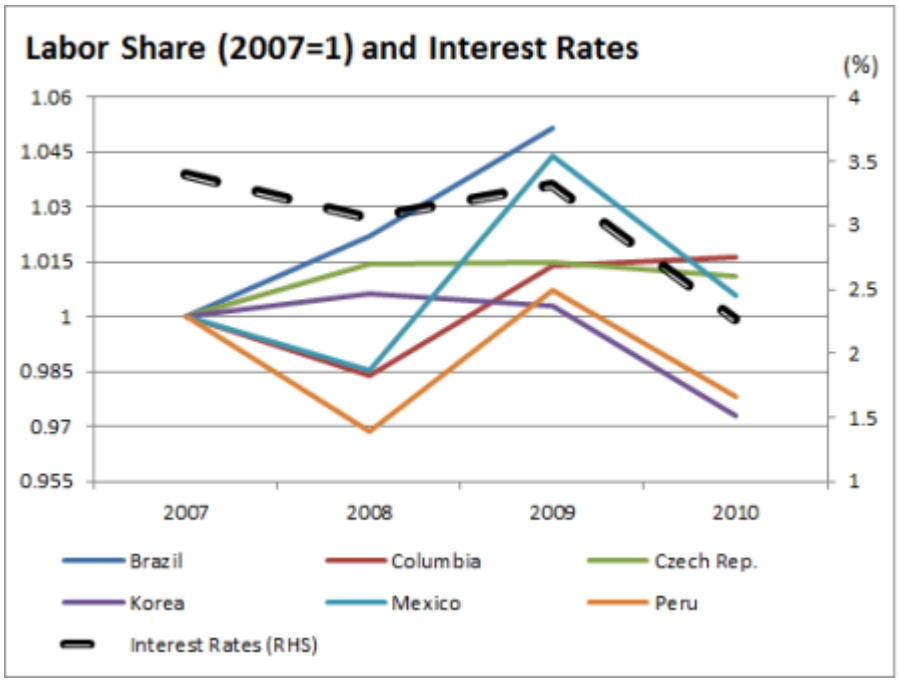
Note: Employment, e, is defined as total annual civilian employment. Employees, ee, are the salaried workers (wage earners). The first and fourth column show the number of annual observations we have over time untill 2008. The source is ILO for Chile, Costa Rica, Peru and Philippines. OECD is the source for Korea, Mexico, and Turkey. For Brazil, we obtain the data from IPEA (national source). For Argentina, employment data comes from the World Bank Development Indicators and the time series of employees comes from ILO.

lationship between labour share and the cost of borrowing across countries presented above. For comparison purposes, we add the cyclical component of the US labour share to the figure as well. It is clear that labour share is much more stable in the US and does not reflect such a pattern we observe in Mexico, Korea, and Turkey.

Emerging Markets and the Global Financial Crisis. We also want to discuss labour share movements in emerging economies during the recent global financial crisis. The 2008-2009 great recession not only hit advanced economies but also caused abrupt slowdown in emerging markets, especially in 2009. GDP per capita (in constant US dollars) dropped by 1.78% in 2009, on average, in our sample emerging markets. This reflects a 5.26% lower growth rate than that reached over 2000-2008. This slowdown was also homogeneous in the sense that all emerging countries except India faced lower rates than over the benchmark period.

How did labour share move during this recession as opposed to output? Figure 2.3 presents changes in labour share for the countries with available data from the UN statistics, i.e, for Brazil, Columbia, Czech Republic, Korea, Mexico, Peru. As previously discussed, these particular economies exhibited procyclical labour share until 2008. By contrast, Figure 2.3 shows no indication of a drop in labour share during their recent GDP slowdown in 2009. In fact, in all countries, labour shares were at a higher level in 2009 than their pre-crisis levels, such as in 2007. These results are surprising given the remarkable slowdown in GDP and the results discussed over 1980-2008. However, we note above that labour share procyclicality appears in countries or during times with countercyclical interest rates. Figure 2.3 shows that, contrary to their previous crisis, the recent crisis did not lead to a significantly higher cost of borrowing in emerging markets. Our analysis shows that the spread these economies faced increased during this period, but lower base rates (US treasury bills) offset this effect. In addition, monetary authorities in EMs were able to undertake expansionary policies in 2009 whereas they were constrained by the large capital flight in their own

Figure 2.3: Labour Share in EMs during the Global Financial Crisis



Note: Labour shares are indexed so that 2007 value is equal to one. Interest rates are the annual aggregation of quarterly real cost of borrowing for the EM countries constructed using quarterly JP-Morgan EMBI Global spreads plus US T-bill 3-month rate constant maturity. The rate is deflated using the average inflation rate over the current and three preceding quarters as the expected inflation. Source: UN data and JP-Morgan EMBI database from the Haver Analytics.

past financial crises.[19]

Other evidence showing the contrast during the recent and earlier domestic crises comes from the Mexican labour compensation index in manufacturing. The index shows an 8.5% drop in total compensation in manufacturing for 2009. In the same year, total GDP and manufacturing GDP dropped by 7% in Mexico. This implies no significant change in labour share, especially when it is considered that the manufacturing sector is highly responsive to changes in GDP. On the other hand, the same compensation index dropped by approximately 20% in the crisis year of 1995 when GDP dropped by

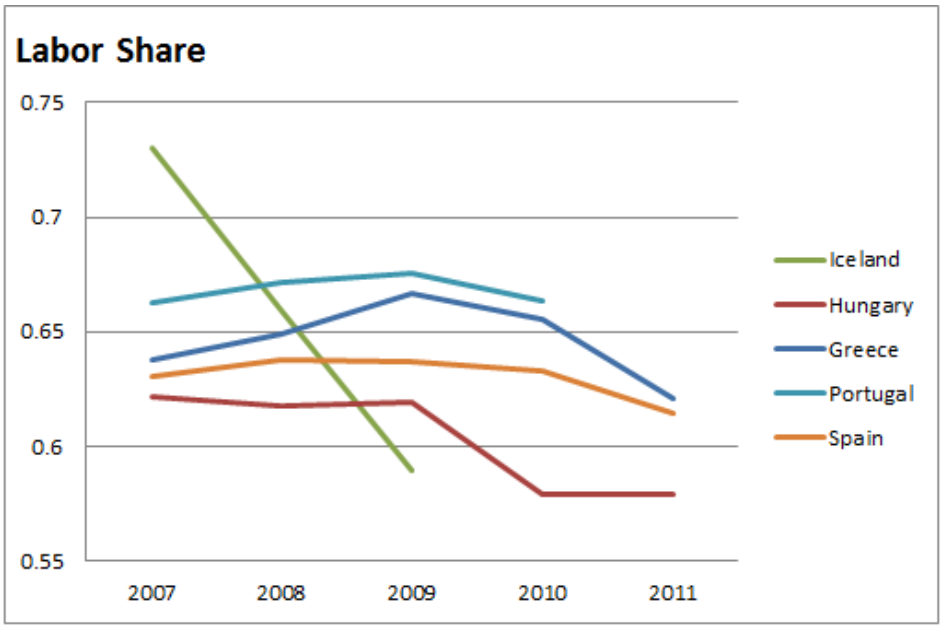
[19]See IMF (2009) for the policy rates during the great recession in EM economies.

6.5%, and the country was experiencing difficulties financing its expenses, either because of the high cost of borrowing or the quantity restrictions on loans. The Mexican cost of borrowing, constructed using Mexican spreads in the Uribe and Yue (2006) data-set, went up to around 20% from 10% levels, whereas Financial Times Emerging Market reports reveal that bid yields on US-dollar-denominated Mexican bonds were around 5-6% during the 2008-2009 recession, levels similar to ones in January 2008. Therefore, these observations from both across and individual country analyses motivate us to explore the effects of financing labour cost on the share of income going to labour.

Developed Economies and the Euro Debt Crisis. For developed economies as well, there is variation in terms of the dynamics of labour share. (see Table 2.2). As mentioned, the developed countries that tend to have countercyclical interest rates, such as Greece, Iceland and Sweden, also tend to have procyclical labour share. These countries are famous for their financial crises (Sweden in 1992 and Iceland in 2008) and had increases in their risk premia in the past. In addition, since 2010 some European economies have faced debt crises and consequently increases in their cost of borrowing. When this dissertation was started, the debt crisis in European economies had not yet begun. However, we have recently obtained data for some of the European countries to track the movements of labour share. Figures 2.4 and 2.5 present movements in the labour share and interest rates for those economies.

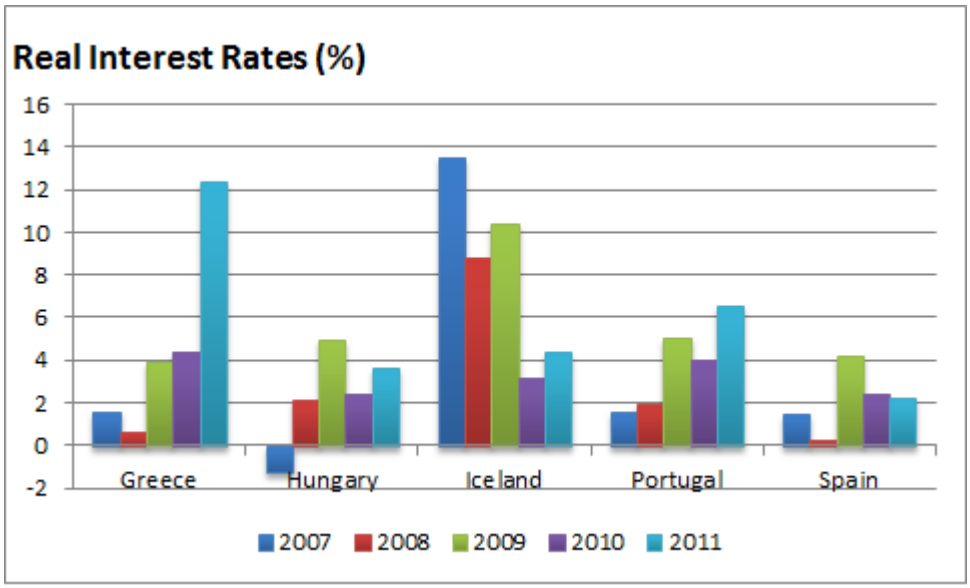
Figure 2.4 shows labour share had a tendency to drop during the times when developed economies started to have debt problems. First of all, there is a sharp drop in labour share for Iceland during 2008-2009. In addition, Figure 2.5 reveals that Icelandic corporations faced large (real) cost of borrowing during these years. Secondly, labour share fell during 2010 and 2011 in countries such as Greece, Hungary, Portugal and Spain. Note that these countries had increases in their risk premia during the years following the Greek debt problems (see, for example, Figure 1.2 in IMF (2012) for the widening spreads in 2010 and 2011). Figure 2.5 also suggests higher costs of

Figure 2.4: Advanced Economies' Labour Share during the Debt Crisis



Note: The figure presents the movements of labour share in European countries which faced increases in risk premium since 2009. Source: OECD.

Figure 2.5: Interest Rates in Selected Advanced Economies during the Debt Crisis



Note: Interest rates are the monthly yields on government bonds (2-years or more) for all countries except Iceland, for which they are the lending rate from financial institutions for Iceland. Rates are deflated using inflation rates in the current period and then aggregated to annual levels. Source: OECD and IFS.

borrowing for those economies during 2010-2011 relative to 2007-2008. We note an increase in real interest rates in 2009 as well; however, this increase was mainly driven by deflation in these economies in 2009 since we assume current inflation as the expected inflation in calculations of real interest rates. The inflation rate in all those years except 2009 was in the range of 2%-5% but it dipped below zero in 2009. Since this phenomenon is rare over the cycle, the assumption for the expected inflation might not hold; therefore, the real cost for 2009 might be distorted. Thus, a comparison between 2007-2008 and 2010-2011 is preferred here, as inflation since 2010 has returned to patterns observed earlier (2%-5%) since 2010.

In short, even countries with more developed financial markets, as opposed to lower income countries, had drops in labour share during periods with a high cost of borrowing – a phenomenon not observed during their previous recessions. Therefore, we claim that there is a strong relationship between the dynamics of labour share and the risk component in the cost of borrowing, independent of income level.

2.3 Robustness Analyses

As mentioned above, data on compensation of employees do not include income from the self-employed. In addition, labour compensation estimates mostly originate from establishment surveys in the formal sector whereas the value-added output, the denominator in equation (1), takes into account the output from the informal sector. If these parts of the economy are countercyclical with output, the results on the procyclicality of labour share would not be reliable. Moreover, sectoral shifts and changes in government expenditures over the cycle might alter labour income shares in the overall economy. In this section, we take all these possibilities into consideration and show that the results discussed above are robust to different measures of labour income shares.

2.3.1 Self-employment Adjustments

Developing countries have high ratios of self-employment. In our sample, self-employment as a ratio of total employment varies between 30%-40% in developing countries. This is in contrast to the ratio in developed markets, around 10%-15% of total employment. One reason for the large number of self-employed people in emerging markets is that agriculture is still widespread in these economies and farmers are counted as self-employed in national accounts. The fact that data on compensation of employees lack the labour income of the self-employed would distort the cyclical behaviour of labour income shares as calculated above if there were significant shifts across different occupations. For example, if a laid-off manufacturing worker moves into farming during a recession, labour compensation will still fall by the amount of his gross salary even though he contributes to the total value added in the country as a farmer.

In order to take into account the labour income of self-employed people in the total labour compensation, we apply two adjustment methods here. The first is to take only incorporated businesses when computing labour share. This requires a deduction in value-added output by an amount equal to the self-employed income (mixed income):

$$\text{Adj-1}: \qquad \text{Labour Share} = \frac{\text{Labour Compensation}}{\text{Value Added GDP - Mixed Income}}$$

The adjustment shown above assumes that labour share is the same across incorporated and unincorporated (self-employed) enterprises and can be applied only to countries that report mixed income in their national accounts. For those that do not report it, we compute a proxy for the labour income of a self-employed person and then adjust the overall economy labour share using self-employment data for those countries:

$$\text{Adj-2}: \quad \text{Labour Share} = \frac{\text{Labour Comp.} + \text{Labour Income per Self-Emp.} \times \text{Self-Emp}}{\text{Value Added GDP}}$$

Labour compensation per employee is calculated by the total labour compensation divided by the number of employees, and this is used as a proxy

for the labour income of a self-employed person, as in Gollin (2002). However, the assumption that the labour cost of the self-employed is equal to the labour compensation per employee might not be valid for some countries. This method lifts the level of labour share up to a very high fraction of income in countries where the self-employment ratio is very high, such as Korea and Turkey.[20] The Korean labour share, for example, rises to 80-90% levels after this correction. We then check household surveys in Korea and Turkey, and verify that the total *gross* income of a self-employed person is around 60% of the average gross wage level. One reason for this is because a big part of self-employment comes from rural areas where the pay is lower. In addition, there might be differences in terms of skills across average workers and those self-employed. Furthermore, self-employed people often work in the informal sector for which the administrative cost of labour, such as labour income tax and social security payments, do not show up on records. Since the total income of a self-employed individual also includes his/her capital income, one should expect for the self-employed a labour compensation lower than 60% of average labour compensation per employee. In the calculations, we assume that the labour income of a self-employed person is half the labour cost of an employee in Korea and Turkey.

The results for adjusted labour share are listed in Table 2.6. There are only minor changes after self-employment corrections. Adjusted labour share still shows a high volatility. In terms of the cyclical comovement of labour share with output, the changes are so miniscule that the adjustment does not alter the sign of correlation between labour share and output. When we plot these adjusted observations with the cyclical properties of interest rates (see Figure A.2) in order to compare with our initial unadjusted Figure 1.2, the main result still holds: the more countercyclical interest rates are, the more procyclical labour share is. This shows that the high procyclicality of labour share in countries such as Argentina, Korea and Mexico is not a measurement error from a calculation that ignores self-employment.

[20] Korea and Turkey have the highest self-employment ratio in the sample taken here. Half of employed people are working for themselves. The average is around 30% in the developing group, whereas it is only 12% in developed economies.

Table 2.6: Adjustments for Self-employment

	Lab. Share		Adj-1		Adj-2	
	σ(s)	ρ(s,y)	σ(s)	ρ(s,y)	σ(s)	ρ(s,y)
Argentina	5.02	0.56	5.60	0.54		
		(0.03)		(0.04)		
Brazil	2.38	0.03	2.88	0.20		
		(0.92)		(0.43)		
Chile	2.36	-0.12			2.18	-0.44
		(0.54)				(0.13)
Colombia	1.22	-0.06	1.15	-0.10		
		(0.88)		(0.67)		
Costa Rica	2.92	-0.22			2.59	-0.46
		(0.26)				(0.03)
Czech Republic	1.37	0.27			1.42	0.17
		(0.30)				(0.33)
Egypt	1.29	0.18	1.35	0.18		
		(0.58)		(0.59)		
Hungary	1.14	0.12			1.51	-0.02
		(0.67)				(0.95)
Korea	1.36	0.44			1.45	0.32
		(0.02)				(0.05)
Mexico	3.72	0.60			3.34	0.58
		(0.0)				(0.0)
Turkey	6.40	0.25			6.22	0.15
		(0.30)				(0.62)
Mean	**2.65**	**0.18**				
Mean (Adj.)	**2.46**	**0.10**				

Note: Adj-1 calculates labour share as the ratio of labour compensation of the incorporate sector over value-added excluding the unincorporated sector. Adj-2 assumes that labour income per self-employed is equal to compensation of the average worker (except in Korea and Turkey) and recalculates labour share as the multiplication of compensation per employees and total employment.

Table 2.7: Cyclical Variation of Self-Employment and Total Employment in EMs

	Brazil	Korea	Mexico	Turkey
$\rho(se, y)$	0.23	-0.28	0.30	-0.29
$\rho(l, y)$	0.50	0.78	0.75	0.35

Note: $\rho(x, y)$ is the correlation between two variables. se denotes self-employment whereas l denotes total employment. The data covers the period after 1990.

The reason self-employment is not a concern for cyclical properties of labour share is because this part of employment does not show a significant comovement with output. Table 2.7 shows the correlations of the cyclical component of self-employment and total employment with output in different countries. Although self-employment is less correlated with output compared with total employment, this is not significant enough to reverse the results on overall labour share. Although self-employment constitutes around 30% of total employment, its contribution to the GDP is only around 10-15%.

2.3.2 Informal Sector Considerations

Another important issue for low-income countries is the high ratios of employment in the informal sector. Comparable estimates from ILO suggest that developing countries in our sample have informal employment (both in formal and informal enterprises) ranging between 40% and 60% of total employment.[21] Labour compensation in the informal sector is not usually represented in the national accounts by the income approach for developing

[21] Informal employment refers to the self-employed in their own informal sector enterprises, contributing family workers (unpaid), members of informal producers' cooperatives (not established as legal entities), employees holding informal jobs (i.e., jobs not subject to national labour legislation, income taxation, social protection or entitlement to certain employment benefits, such as sick leave); own-account workers engaged in production of goods exclusively for own final use by their household.

countries.[22] On the other hand, the value added GDP has estimates of the production in the informal sector. In these countries, though, an important part of employment in the informal sector actually comes from unregulated self-employment (Thomas (1992) and De Soto (1990)). Therefore, adjustments that we have done for the self-employed partially correct informality problem, too.

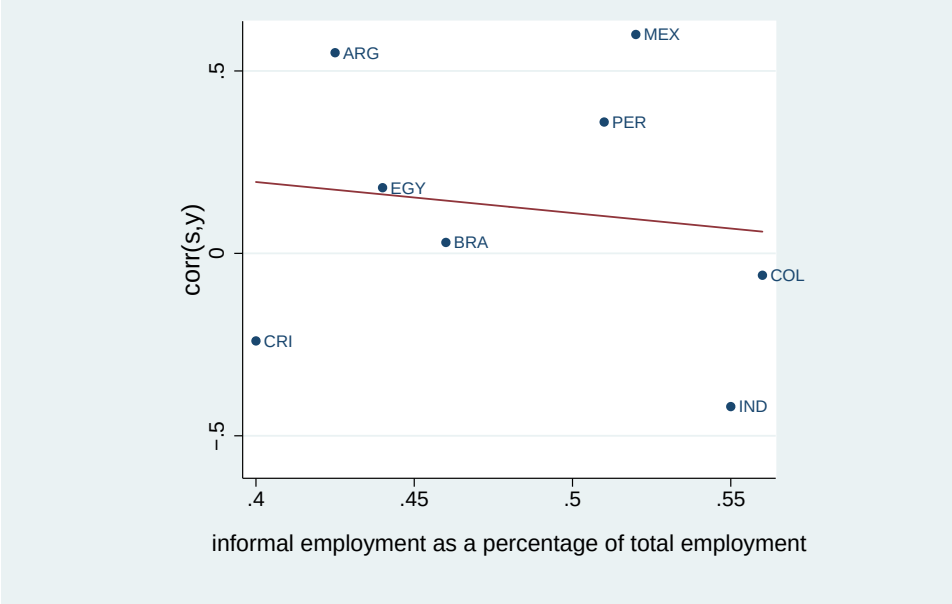
Another possibility here is to analyze comparable cross-section data on informality that we have obtained from ILO, in order to see if different cyclical patterns exist in different levels of informality. The possible theory behind here is that a large informal sector would absorb more employment during recessions, which would push the labour share down. Figure 2.6 plots the cyclical patterns of labour share with respect to informal employment observed in developing countries, with comparable data availability. If informality – strictly speaking, the lack of informality in the labour compensation – were the main driver of the procyclical labour share, we would observe a higher correlation between labour share and output in countries with a larger informal sector. However, we do not observe such a pattern in Figure 2.6. In fact, countries with the highest ratios of informality (Colombia and India) have a significantly smaller correlation of labour share with output than the others. Therefore, it is hard to say that the absence of labour compensation from the informal sector accounts for the procyclical labour share.

Additional evidence comes from Mexico.[23] Official authorities release information on the contribution of the informal sector to total value added. We plot them in Figure 2.7. Besides its small contribution to GDP in Mexico (on average, 12.4% of the value added), a crucial takeaway from the figure

[22] Having said that, we should also note that informal employment in the formal sector is included in the official labour compensation since the data is usually derived from estimates in the formal sector. It is employment in the informal sector that is missing in the official compensation of employees.

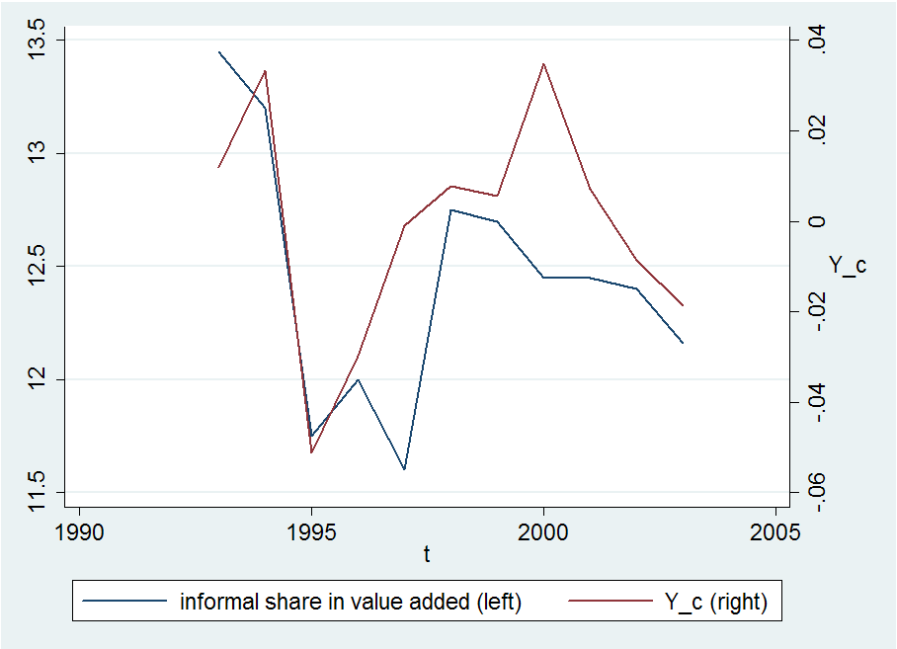
[23] Throughout the dissertation, we sometimes concentrate on Mexico, especially from disaggregated data. The main reason for this is Mexico is a country with ample data available. Moreover, the reader will see that models in Chapter 2 and 3 are calibrated to the Mexican economy. Therefore, we want to make sure that potential concerns about the Mexican labour share are addressed and proven not effective.

Figure 2.6: Informality and the Cyclical Properties of Labour Share



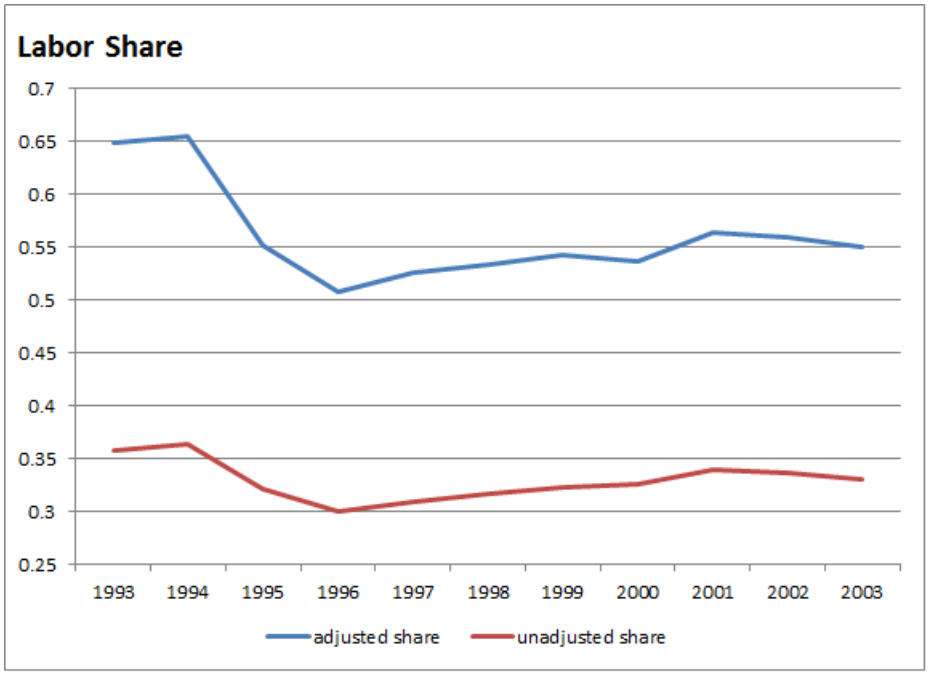
Note: *Corr(s,y)* denotes the correlation between the cyclical components of labour share and output. Data on the informal employment is the cross-section data in 2000, and covers employment in the informal sector as well as informal employment in the formal sector (informal jobs in formal enterprises). See the text for details of the coverage. Source: ILO for the informal employment.

Figure 2.7: Informal Sector as a Share of GDP in Mexico



Note: The figure presents the contribution of the informal sector to the value added in Mexico. Data period: 1993-2003. Source: INEGI

Figure 2.8: Labour Share Adjusted for Informality and Self-Employment in Mexico



Note: Adjusted share is obtained first taking care of the informal sector by adjusting official labour compensation data using the contribution of the informal sector to the value added. The implicit assumption here is that labour content is the same across formal and informal sectors. Then, this is further adjusted for self-employment to account for the labour income of the self-employed.

is that the informal sector actually moves quite cyclically with output in Mexico. Therefore, the absence of labour cost from the informal sector in the official labour compensation data tends to work in the opposite direction for the observed positive correlation between labour share and output. This is perhaps the reason we do not observe a greater procyclicality for labour share in countries with larger informality. Thus, the informal sector might actually shrink during recessions in other developing economies, as in the case of Mexico.

Lastly, using the informal sector's contribution and the self-employment ratio between 1993-2003, we adjust labour share in Mexico. Figure 2.8 compares the adjusted share to the unadjusted one. First of all, the adjusted one is significantly larger than the unadjusted: the difference between them is 24% of the value added. More importantly, the adjusted one still keeps the same cyclical pattern that the unadjusted one follows. The correlation coefficient between the two is 0.94. In addition, the adjusted one becomes even more volatile due to the highly cyclical properties of the informal sector. In summary, although the level of labour share suffers from the informality problem, the cyclical component does not.

2.3.3 Sectoral Shifts and Government Expenditure over the Cycle

Another driving force in the change of labour share might be shifts across sectors over the cycle. This is because different sectors in the economy have different labour intensities. Manufacturing, particularly, has a lower share of labour income, compared with the service sectors. For instance, during 2000-2007, 59% of income generated in US industrial sectors (including manufacturing, electricity, gas and water supply, and construction) went to labour. This is in contrast to 70% in service sectors such as trade, transport, and financial services.[24] We observe similar differences in intensities

[24] During the same period, the labour share in trade, transport, and communication was 0.69, and that in financial services and professional business services such as real estate was 0.71.

in a developing nation such as Mexico, as well. Labour share (adjusted with self-employment ratios) between 2000 and 2007 was 0.30 in industrial activities whereas in Mexico it was 0.44 in Mexican service sectors.[25]

These dissimilarities in labour intensities across sectors might generate procyclical labour share if the contributions of sectors to the economy are cyclical over the cycle. Specifically, if the share of manufacturing in the value added increased during recessions, we would observe a decline in labour share making it procyclical with output. We document in Table 2.8 the cyclical properties of the contributions of sectors with the overall output. The main result from Table 2.8 is that there is no significant patterns for sectoral shifts over the cycle in emerging markets. When we narrow the sample to the economies with procyclical labour share from Table 2.1, the result does not change. Therefore, the procyclicality of labour share cannot be attributed to sectoral shifts during boom and bust cycles.

In addition, we present some more evidence from Mexico and Korea on the changes of industry-specific labour share. Figure 2.9 shows the paths for labour share (adjusted using sectoral self-employment ratios similar to that in the previous section) in major sectors in Mexico and Korea since 1980s, including industry, trade, transport and communication, and financial and business services. The main observation here is that all these sectors follow similar cyclical patterns. When labour share in the overall economy drops, shares in all sectors tend to drop, too. Indeed, the cyclical component of labour share in every sector is positively correlated with that in the overall economy.[26] Therefore, the movements in the overall labour share over the cycle are not driven by sectoral reasons.

Another explanation for the procyclical labour share could be changes in the government expenditure over the business cycle in emerging markets.

[25]The source for the industry-specific shares for Mexico is the OECD. Note that, even when adjusted, the labour share seems to be much lower in Mexico than in the US in both sectors of the economy. This is partially due to the lack of labour compensation from the informal sector, discussed above. Another potential reason might be different market structures and bargaining powers across countries.

[26]The lowest correlation is 0.33, coming from the trade sector in Korea. All other correlation coefficients in both countries are greater than 0.42.

Table 2.8: Sectoral Shifts over the Cycle in EMs

Country	$\rho(ind, y)$	$\rho(ser, y)$	$\rho(agr, y)$
Argentina	-0.20	0.46	-0.67
Brazil	-0.42	0.40	-0.13
Chile	0.04	-0.10	0.14
Colombia	-0.28	0.26	-0.01
Costa	0.48	-0.54	0.10
Czech	0.08	-0.34	0.41
Egypt	-0.05	0.08	-0.06
Hungary	0.21	-0.14	-0.11
India	0.39	-0.7	0.24
Korea	-0.04	0.08	-0.11
Mexico	-0.21	0.17	0.05
Peru	0.26	-0.34	0.32
Philippines	-0.36	-0.19	0.35
Poland	0.41	-0.56	0.17
Russia	0.05	-0.26	0.37
South	0.05	-0.26	0.42
Turkey	0.04	-0.19	0.23
Mean	0.03	-0.13	0.10
Mean*	-0.02	-0.01	0.02

Note: The table documents the correlations between detrended shares of three major sectors – industry, services, and agriculture – in the value added with detrended real GDP. A positive correlation denotes an increase in the share of that sector in output during economic expansions. The data period is the same as in Table 2.1. *Industry* includes the sectors of mining and quarrying, manufacturing, electricity, gas and water supply, and construction. *Agriculture* covers agriculture, hunting, forestry, and fishing. Finally, *services* includes all the other sectors combined. Data is not available for Israel. Mean* denotes the average of correlations for countries with significantly procyclical labour share from Table 2.1: Argentina, Czech Rep., Egypt, Korea, Mexico, Peru, Turkey. Source: World Economic Indicators (World Bank).

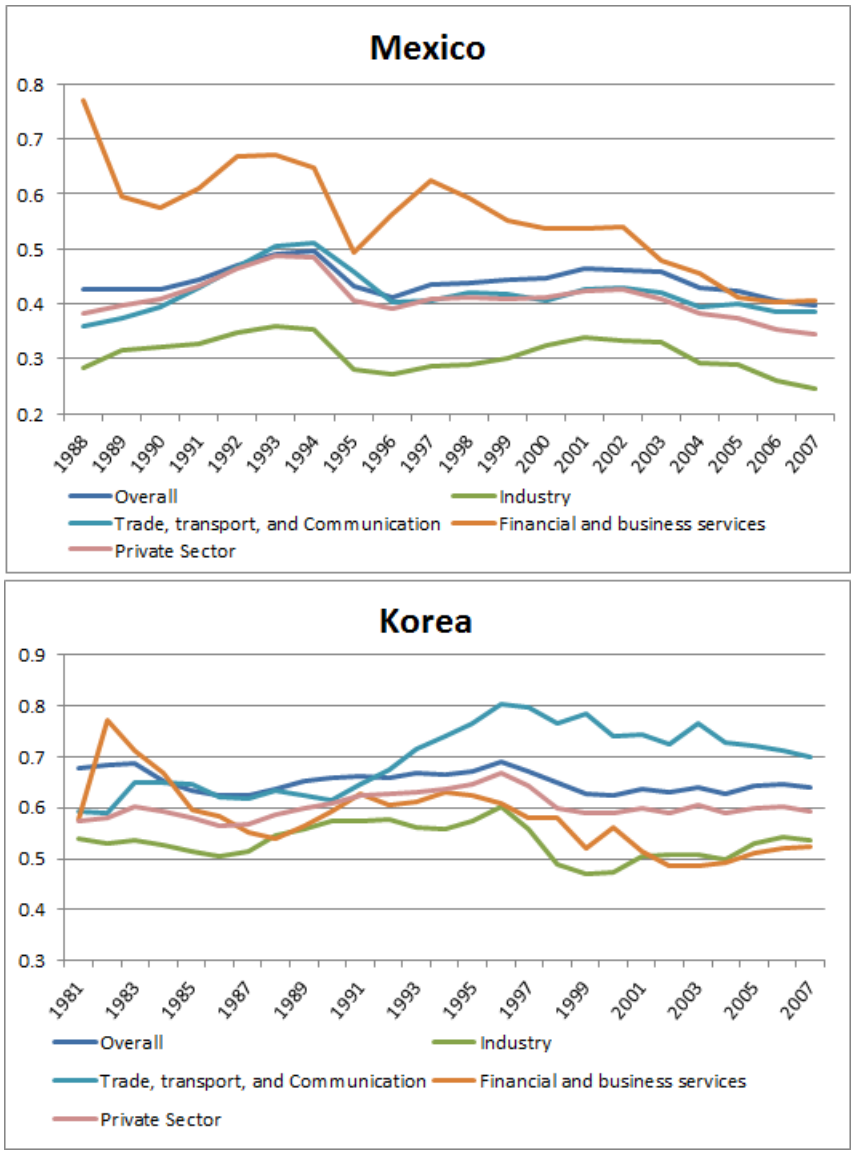
This is true if the public sector is procyclical and more labour intensive than the other sectors. It is well-known that the government expenditure is procyclical in these economies (see Kaminsky et al. (2004) for the cyclical properties of policy responses in EMs). However, even when we exclude the government sector (which is mainly services such as health, education, and administration), we still observe procyclical labour share in countries such as Mexico and Korea. The pink lines in Figure 2.9 represent the labour share in the private sector in these economies. It shows that the labour share in the private sector follows the labour share in the overall economy. This is mainly because the public sector represents only 10% to 20% of the output during the sample period. This observation is consistent with the above-mentioned fact: the sectoral shifts over the cycle are neither systematic nor significant in emerging markets.

2.4 Interest Rates and Financial Environment

The variation in the cost of borrowing that emerging market economies face in international markets is widely discussed in the macro literature. Neumeyer and Perri (2005), and Uribe and Yue (2006), document the countercyclical behaviour of interest rates for a number of emerging markets. Here, we show that domestic real rates (Table 2.1) also support this behaviour. As in previous studies, Argentina, Brazil, Korea, Mexico, and Turkey exhibit highly countercyclical interest rates. In contrast, the Philippines and South Africa have a cost of borrowing that mildly responds to output changes. The countercyclical movement of interest rate is mostly explained by default risk variation over the cycle. Arellano (2008) derives high probabilities of default in equilibrium during a recession when there is less incentive for repayment in incomplete markets. This, in turn, leads to higher interest rates and consequently causes more output contractions (see Neumeyer and Perri (2005) and Uribe and Yue (2006)).

During financial distress, borrowing becomes not only more costly but also more limited to agents that engage in risky investment activities. Thus, principal-agent problems might be even more apparent during recessions.

Figure 2.9: Labour Share across Industries in Mexico and Korea



Note: Labour share is adjusted using sector-specific self-employment ratios (the second method in the text). For the Korean adjustment, see the details in the text. *Industry* represents mining and quarrying, manufacturing, electricity, gas and water supply, and construction. *Private Sector* covers all the sectors excluding the public sectors, such as health, education, and administration. The sectoral labour share data start at 1988 for Mexico, and 1981 for Korea.

Stiglitz and Weiss (1981) explain credit rationing as an equilibrium phenomena in an environment where agents differ in terms of their risk, and financial markets are monopolistically competitive. Indeed, macroeconomic implications of financial frictions are heavily touched upon in the literature. Examples in the literature of developed markets include Kiyotaki and Moore (1997), Bernanke et al. (1999), Aiyagari and Gertler (1999), and Holmstrom and Tirole (1997). These works address the high cost of recessions when the agents are credit constrained.

In emerging markets, these frictions are still important, especially when their level of financial development is considered. In an empirical study, Arteta and Hale (2008) find that crises are accompanied by a sharp decrease in foreign credit when firm-specific and country-specific characteristics are controlled. Their study also reveals that the credit level remains low for a couple of quarters and only recovers after macro-fundamentals improve. In a theoretical perspective, the effects of financial frictions on large output drops in emerging markets have been emphasized by Aghion et al. (2001), Caballero and Krishnamurthy (2001), and Calvo (1998). Moreover, Mendoza and Smith (2006) and Mendoza (2010) stress the importance of financial frictions on the crashes of asset prices in emerging markets.

Empirical studies on the leverage ratio (measured as debt liabilities over the market value of equity or total credit as a percentage of output) also shed some light on large credit booms and sharp declines. Gourinchas et al. (2001) and Mendoza and Terrones (2008) show that credit expansions play a significant role for output expansions in emerging countries. In fact, the private credit to GDP ratio displays a positive movement with output in these countries (see, for example, Figure 3.3 in Chapter 3 for the cyclical pattern of the private credit-to-GDP ratio in Mexico over time). Previous studies deliver some explanations on volatile credit, such as poor monitoring on banks' lending activities,[27] bailout guarantees aggravating moral hazard issues,[28] and imperfection in credit markets serving as a financial accelera-

[27] Lorenzoni (2008) points out the need for financial supervision as a second-best option.
[28] Ranciere et al. (2008) and Schneider and Tornell (2004)

tor.[29]

Motivated by these facts, we show in Chapter 3 that a model with countercyclical interest rates, as well as labour financing through working capital loans, can account for some of the variation in the labour share of emerging markets. We further show that perfect credit markets with highly volatile and countercyclical interest rates hardly explain the above-mentioned large credit expansions and procyclical leverage ratios. When we introduce leverage constraints, not only the movements of the aggregates of the goods market, such as consumption, but also the variation of the labour share is amplified in the model. Thus, both the level of interest rates of external financing and borrowing constraints will be proven responsible for the cyclical properties of the labour share presented in this chapter.

2.5 Conclusion

In this chapter, we show that emerging markets tend to have a more volatile and procyclical labour share in contrast to developed markets. Rather than the income level, this cyclical pattern is more related to the cyclical properties of the cost of borrowing. Procyclicality increases as the country faces stronger countercyclical interest rates among emerging markets as well as developed markets. Since countercyclical interest rates usually appear in emerging markets, we observe more procyclical labour share, on average, in these economies. These results are shown robust to adjustments in the labour share and are not caused by sectoral shifts over the cycle.

We also show that these patterns are showing signs of reversal in the aftermath of the recent global financial crisis. The procyclicality of labour share tends to disappear after the 2000s in emerging economies having better financing outlook relative to earlier times. On the other hand, economies which have seen increased risk premia in their borrowed funds, such as some of the European countries, tend to have lower shares of income going to labour, suggesting a procyclical movement for labour share.

[29] See Gourinchas et al. (2001) for a summary of these explanations.

Chapter 3

The Role of the Cost of Borrowing on Labour Share Fluctuations in Emerging Markets

3.1 Introduction

We documented in Chapter 2 that labour share is relatively volatile and moves positively with output in emerging markets (EMs), in contrast to its cyclical behaviour in developed markets (DMs). This procyclicality of labour share appears especially in countries with countercyclical cost of borrowing. This chapter gives a theoretical explanation for those cyclical observations, and compares business cycle implications of the model with data moments.

The model presented here implies a varying labour share even with a Cobb-Douglas production function, which implies a constant share in standard frictionless RBC models. The key mechanism resulting in those variations in labour share is the wage-in-advance requirement in the model: Firms have to borrow in order to pay workers before the production takes place and sales are cashed out.[30] Even if the firm used its own resources for the wage-bill financing, instead of borrowing, labour decisions would still be affected as this creates an opportunity cost in a world with a positive return on bonds. The liquidity need to finance the wage bill makes labour

[30] Barth III and Ramey (2002) discuss the dataset for US firms and show that working capital, including the value of inventories and trade receivables, is 17 months of final sales, on average, over the period 1959 to 2000.

demand sensitive to interest rate changes. The duration between the time when labour income is paid and the time when the goods market clears will create an extra cost on the wage bill, namely interest payments to the rest of the world.[31] During a recession, the share of output that goes to the rest of the world increases due to the higher interest rate, which lowers the labour share of output. Additionally, we study limits on borrowing capacity as opposed to a perfect-credit scenario. The introduction of these limits together with working capital requirement generates an effective interest rate that is higher than the observed one, and leads to larger responses in the labour share relative to those in the perfect-credit scenario.

In the quantitative-analysis section, we calibrate the model to Mexico, and show that working capital mechanisms can generate the right comovement of labour share with output, as well as explain part of the volatility in labour share, cyclical properties of which are shown in Figure 1.1 and Figure 1.2. In addition to this effect, the results are amplified when the agents are credit constrained. The baseline model with both working capital and leverage constraint can account for 60% to 73% of the variation in the Mexican labour share depending on the level of the working capital requirement. The presence of the binding leverage constraint not only amplifies the response of labour share but also improves the performance of the model with respect to other business cycle regularities in emerging markets, particularly highly volatile consumption, highly procyclical investment and consumption, and countercyclical net exports with output.

This chapter is related to the literature that previously studies the different behaviour of interest rate that emerging markets face. As opposed to slightly procyclical interest rates in developed markets, the countercyclical interest rates are mostly explained by the country-risk premium (see Arellano (2008)). Neumeyer and Perri (2005), and Uribe and Yue (2006) also show that countercyclical interest rates due to default risk can be a prop-

[31] The use of medium or long-run post-dated checks and illiquid assets as the return to goods sold will increase the liquidity burden on wage bill. This is not only due to the time lag between wages are paid and sales are cashed out, but also because of the uncertainty in drawing checks which might be high during recessions.

agation mechanism to generate business cycle fluctuations in this group of countries; however, they do not address the implications on labour income. Recently, Li (2011) studies that these models along with income effect on labour supply can explain a significant part of the wage volatility.[32] Here, our contribution to these models is twofold. Firstly, we show that these models with working capital requirement have implications also on labour share movements. Secondly, we show that under the shock processes calibrated consistently with the data, the perfect credit used in the above-mentioned models is not substantial enough to match fluctuations in these countries, such as highly volatile consumption and countercyclical net exports. This is why we emphasize imperfect credit together with working capital requirements.

Interest rates are not the only cost of borrowing developing countries face. Credit frictions are also significant for these lower income economies. Arteta and Hale (2008), for instance, find additional decline in foreign credit to private sector as high as 20% of country-specific average after debt crises. This decline is not temporary, either. It persists more than two years, which potentially aggravates the recession and affects business cycle fluctuations. In terms of the macroeconomic implications of credit frictions, there are numerous studies in the literature following Kiyotaki and Moore (1997) and Bernanke et al. (1999).[33] These studies highlight the importance of credit frictions in the fluctuations of developed markets. A significant role of these frictions can be expected in developing countries as well, especially when their relatively low level of financial development is considered. Calvo (1998) and Caballero and Krishnamurthy (2001), in fact, study the effects of financial frictions on output drops in emerging markets. Recently, Mendoza (2010) points out that the real cost of borrowing can be amplified in sudden

[32] At the time of writing this dissertation, earlier version of Li (2011) was studying a contractual model, in contrast to a Walrasian model presented here and in the final version. Therefore, the last version makes the model in her paper closer to the model here except that we also investigate the impact of imperfect credit and concentrate on labour share fluctuations.

[33] See Kocherlakota (2000), Aiyagari and Gertler (1999), Devereux and Yetman (2009), Jermann and Quadrini (2006) for the use of financial constraints.

stops through credit frictions.[34] This paper stands on the same line with this literature and claims that when working capital is introduced, these models have important implications on the short-run dynamics of labor share thanks to volatile cost of borrowing, whether it be the observed one in the market or the effective one through imperfect credit.[35]

Another recent paper by Boz et al. (2009) studies labour income fluctuations in emerging markets. They incorporate search and matching frictions in a small open economy real business cycle (SOE-RBC) model with countercyclical interest rates to explain wage volatility in EMs. In these models, wages fall in recessions more than in a frictionless world due to the negative effect of higher interest rates on the outside option of workers, namely the value of unemployment. Chapter 4 will compare this type of frictions to financial frictions proposed in this chapter in order to evaluate the relative impact of search frictions to financial frictions on labour income fluctuations in EMs, and conclude that the relative impact is smaller when households endogenously choose hours per worker.

Besides the fluctuations in emerging economies, we also study in Section 3.5 the performance of the model presented here in a developed market, Canada, and conclude that the model implies more or less stable labour share that is slightly countercyclical with output. This is because interest rates in developed markets display a slight positive correlation with output perhaps implied by an increase in marginal product of capital as a response to positive productivity shocks (see Kydland and Prescott, 1982) and/or the effectiveness of monetary authorities that might have an impact on real variables in the short-run (see King and Watson, 1996).

Labour share movements in developed markets have already been addressed in the literature. Ríos-Rull and Santaeulalia-Llopis (2009) show that when we allow labour share to have a dynamic response, it displays an overshooting property as a response to a positive productivity shock.

[34] The difference here is that credit frictions are not temporary; rather they affect business cycles implications.

[35] By saying imperfect credit, I not only consider credit rationing in the financial system, but also mean leverage cycles explained by various types of asymmetric informational frictions in the emerging market asset as in Fostel and Geanakoplos (2008).

Thus, labour share falls down on impact, then starts to increase, and after a couple of quarters it passes beyond the steady-state level and stays above the mean for a long time.[36] These findings show that there are some mechanisms or frictions that prevent labour share from initially responding as it does in the medium run. Bentolila and Saint-Paul (1998) empirically show that adjustment costs on labour and union-wage bargaining have a significant effect on the movements of labour share. Bentolila and Bertola (1990) use adjustment costs – specifically, firing costs – to explain countercyclical labour share in European countries. Ríos-Rull and Choi (2009) emphasize the effect of non-competitive wages and search frictions on the labour share dynamics in a developed market, namely the US. Boldrin and Horvath (1995) and Gomme and Greenwood (1995) use contractual agreements between workers and employers in which real wages deviate from the marginal product of labour. This mechanism also makes total wage bill less responsive to output and generates countercyclical labour share. Following these papers, when the model implications of a developed market are compared to those of an emerging market in Section 3.5, we include a labor adjustment cost to the model so as to analyze how much sluggishness in labour market contributes to the cyclicality of labour share. The result is that working capital channel is the predominant factor explaining labour share fluctuations in EMs through volatile interest rates. In contrast, other factors producing less responsive wage bill explain more the movements in the labour share in DMs.

The plan for the rest of the paper is as follows. Section 3.2 presents the model, and section 3.3 describes the calibration method for the parameters. Section 3.4 discusses the main findings, and compares them to data moments. Section 3.5 extends the model with an adjustment cost on labour and shows the implications of this model in EMs and DMs. Section 3.6 concludes.

[36] Using Mexican quarterly data, we also find evidence on overshooting property in labour share. However, in this work, we are interested in the immediate response of labour share in emerging markets which is procyclical.

3.2 Model

The model is in the class of small open economy real business cycle models with an internationally traded single good.[37] Asset markets are incomplete in the sense that there is only one single internationally traded one-period bond which pays the buyer a predetermined interest. Agents face shocks in the interest rate on bonds and productivity level. These shocks follow exogenous processes, the details of which are described below. The difference from a standard RBC model is that wages have to be paid in advance and that the country is credit constrained.

3.2.1 Optimization Problem

Let us consider an economy with an infinitely-lived self-employed representative household.[38] The agent derives utility from consumption c_t and leisure $1 - l_t$, where the total time that he devotes to labour and leisure is normalized to one. His preferences are described as follows:

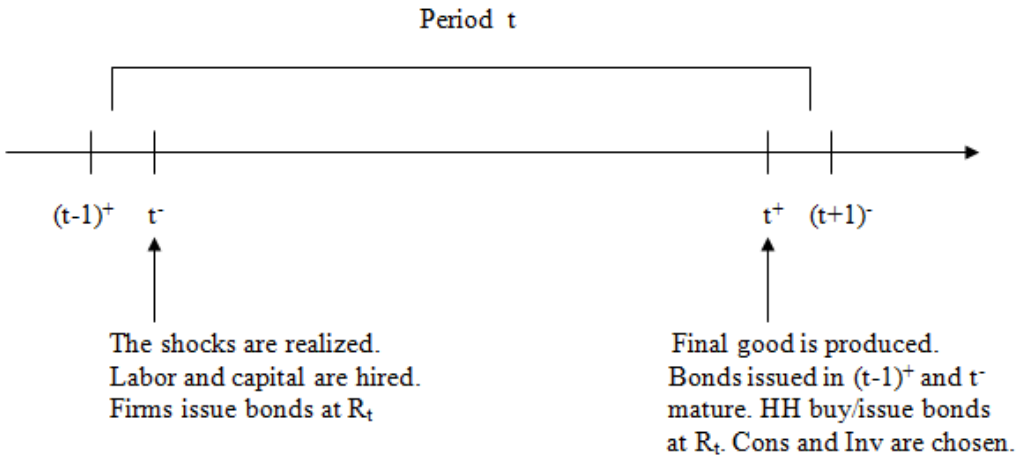
$$\sum_{t=0}^{\infty} \beta^t E_t u(c_t - N(l_t)) \tag{3.1}$$

where $0 < \beta < 1$ is the discount factor, $u(.)$ is twice-continuously-differentiable and a concave period utility function, and $N(.)$ expresses the disutility of labour which is twice-continuously-differentiable and a convex function. This utility representation is known as GHH preferences after Greenwood et al. (1988). These preferences eliminate the wealth effect and make labour supply decisions independent of consumption. Neumeyer and Perri (2005) show that the standard Cobb-Douglass utility function generates large wealth effects when interest rates are volatile and countercyclical, and results in

[37] Our main motivation for real business cycle model –rather than a model with nominal rigidities– is the high CPI and wage inflation observed in developing countries. Thus, we verify that nominal wages are also highly volatile in these economies.

[38] This is similar to the yeoman-farmer model, in which the farmer uses his own labour to produce the good, which is widely used in monetary literature (see Ball and Romer (1990) and Mankiw (1985)). The alternative is to use a decentralized representation which has households and firms as separate agents. We choose this type of modeling since it allows us to impose a constraint on the whole nationwide debt, including both household debt and working capital loans (see Mendoza (2010)).

Figure 3.1: Timing Line



counterfactual employment movements. An alternative to this form would be to use standard preferences with asset market segmentation to lessen the effect of interest rates on labour supply decisions. However, this specific form is chosen due to its simplicity to deal with the wealth effect.

The agent maximizes the life-time expected utility and chooses the optimal sequences of consumption, c_t, labour, l_t, investment, x_t, and bond holdings, b_t, subject to budget and leverage constraints:

$$c_t + x_t + b_t + \kappa(b_t) \leq y_t - \theta(R_t - 1)w_t l_t + R_{t-1}b_{t-1} \tag{3.2}$$

$$b_t - \theta R_t w_t l_t \geq -\psi_t y_t \tag{3.3}$$

Income, in this economy, is generated by producing a single traded good, y_t, using a constant-returns-to-scale technology which has capital, k_t, and labour, l_t, as the factors of production:

$$y_t = A_t F(k_t, l_t) = A_t k_t^{\alpha} l_t^{1-\alpha} \tag{3.4}$$

where α is the capital elasticity in the production and A_t is the total factor

productivity. The agent chooses an investment level, x_t, in order to accumulate capital by taking into account the fact that capital depreciates at a rate, δ. Capital accumulation follows the law of motion:

$$x_t = k_{t+1} - (1-\delta)k_t + \Phi(k_{t+1}, k_t) \tag{3.5}$$

where $\Phi(k_{t+1}, k_t)$ is a quadratic convex capital adjustment cost to mitigate the excessive volatility of investment that might arise in small open economy models. The agent can also trade an international one-period bond, b_t, in the market that has a gross return, R_t. A quadratic convex cost function, $\kappa(b_t)$, is introduced into the model as in Schmitt-Grohé and Uribe (2003) to ensure a stationary path for bond holdings.[39]

The model has a wage bill financing, that is, a fraction θ of wage bill has to be paid in advance of the production. This can be rationalized either by the fact that workers want to consume in the beginning of the period but cannot access the financial markets or by having a production line where firms use installments or post-dated checks so that sales are cashed out in later periods. In the model, these working capital loans are borrowed in the beginning of the period from international markets at the same rate on the bond, R_t, after the shock is realized and generate interest payments in the end of the period to the rest of the world (see Figure 3.1 for a representation of the timing line). That is why the income net of these payments are entered in the right-hand-side of the budget constraint. The labour market is competitive. Therefore, the wage is taken as given by the representative agent and is equal to the marginal disutility of labour:

$$w_t = \partial N(\bar{l}_t)/\partial \bar{l}_t \tag{3.6}$$

where $\bar{l}_t$ is the market average. This is similar to the optimal labour supply in a decentralized competitive equilibrium set-up.

The economy also faces an external leverage constraint given in equation

[39] This cost is zero in imperfect credit since non-stationarity does not exist in this case and it is so small in the perfect credit case that it does not affect the long-run business cycle implications of the model.

(3.3). The net foreign asset is constrained by a fraction of output, $-\psi_t$. In other words, net debt including working capital loans has to be smaller than a ψ_t fraction of output. This fraction has a stochastic component and varies over time. Ludvigson (1999) finds that forecastable (ex-ante) credit growth has a significant influence on consumption that is independent of variation in predictable income growth. Furthermore, she shows that introducing a stochastic upper limit on the debt-to-output ratio improves the correlation between consumption and income growth in the US. The high correlation between consumption and income appears in emerging markets, as well.[40] In the quantitative exercise with perfect credit markets, we will see below that the model with working capital cannot account for highly volatile (and highly cyclical) consumption and countercyclical net exports even in the presence of countercyclical interest rates. A stochastic leverage constraint, however, can indeed improve these results.[41]

Another issue is how frequently these leverage constraints bind over the cycle, which cannot be directly observed from data. Stiglitz and Weiss (1981) show that financial imperfection, as in the form of quantity restrictions, can be an optimal equilibrium outcome in every state of nature when there are asymmetric informational costs in the environment.[42] Moreover, considering the low levels of financial development in emerging markets, these kinds of constraints are more likely to bind. In this dissertation work, we narrow the scope to see how the presence of binding constraints interacts with working capital by assuming that the constraint binds permanently. Since the constraint binds at every state, ψ_t represents the leverage ratio of the economy as the net debt over GDP. Motivated by interest rates being an important driving force in emerging markets, the leverage ratio is assumed

[40] See Aguiar and Gopinath (2007) for the documentation of business cycle regularities in emerging markets.

[41] Sarquis (2008) and Guajardo (2004) also explore the effects of these types of credit shocks in emerging market business cycles. The difference here is that we introduce working capital channel in order to explore the effect of changes in the effective cost of borrowing on labour market variables.

[42] See Mandelman (2011) for more on monopolistic competition among emerging-market financial institutions.

to move over the cycle in the following way:

$$\widehat{\psi}_t = -\eta \widehat{R}_t \tag{3.7}$$

where $\eta > 0$. This tells us that the economy faces credit restrictions (such as losing access to financial markets) during financial crises when spreads and interest rates are high. Our motivation comes from the empirical evidence on foreign credit supplied to private sector in emerging markets. Arteta and Hale (2008), for instance, find debt crises are accompanied with a significant and persistent drop in foreign credit after controlling fundamentals. In addition, Fostel and Geanakoplos (2008) document that during closures emerging market bond issuance drops even though its spread has increased minimally relative to other assets – during mild recessions. They show that this phenomenon can be explained in a financial environment where lenders cannot distinguish bad credit from good credit. Therefore, the exogenous structure of leverage ratio can be endogenized through the mechanism in Fostel and Geanakoplos (2008), which imply positive correlation between tightening and interest rates.[43] Furthermore, the increase in the asymmetric information cost – driving spreads up for these economies – can cause monopolistically competitive banks to not only charge high interest rates but also to impose tighter restrictions on credit in the framework described by Stiglitz and Weiss (1981). This specification would imply a one-to-one relation between interest rates and leverage ratio. The observed relationship between these two variables in the data are consistent with these explanations. Private sector credit-to-GDP ratio for non-financial firms shows a high correlation of -0.60 with interest rates in Mexico (see Figure 3.3).

3.2.2 Competitive Equilibrium and Labour Share

A competitive equilibrium for this economy consists of sequences of optimal allocations $\{c_t, l_t, k_{t+1}, b_t, x_t, y_t\}$ and wages $\{w_t\}$ such that

[43] The external borrowing is crucial here as a model with heterogenous agents and binding collateral constraints in a closed economy might imply a negative correlation between those two variables under endogenous interest rates.

1. the representative agent solves the maximization problem subject to budget and collateral constraints in (2), taking wages, interest rate, and initial states k_0 and b_0 as given,

2. wage equals the marginal disutility of labour $w_t = \partial N(\bar{l}_t)/\partial \bar{l}_t$,

3. labour decisions satisfy $\bar{l}_t = l_t$, and

4. goods market clear, meaning that the goods that are not spent on consumption, investment, and the cost of bond holdings, represent the net export for the economy:

$$c_t + x_t + nx_t + \Phi(b_t) = y_t \tag{3.8}$$

Given the problem described above, the optimal condition for bond holdings and capital accumulation can be expressed as:

$$\begin{aligned} \lambda_t[1 + \Phi'(b_t)] &= \mu_t + E_t \lambda_{t+1} \beta R_t \qquad (3.9) \\ \lambda_t[1 + \Theta_{2,t}] &= \beta E_t[\lambda_{t+1}(1 + A_{t+1}F_{1,t+1} - \delta - \Theta_{1,t+1} + \mu_{t+1}\psi_{t+1})] \end{aligned}$$

where the subscript in the functions denotes the partial derivative of the function with respect to its argument numbered. These conditions tell us that bond holdings and capital accumulation are at their optimal level when the cost of an additional bond/capital accumulation is equal to the discounted benefit to the households. The expression μ_t is the Lagrange multiplier on leverage constraint at period t representing the marginal value of relaxing the leverage constraint. The other Lagrange multiplier on budget constraint, λ_t stands for the marginal utility of consumption:

$$\lambda_t = u_c(c_t, l_t) \tag{3.10}$$

Finally, the optimal condition for labour demand in this economy can be written as follows:

$$-u_2(c_t, l_t) = \lambda_t[A_t F_2(k_t, l_t) - \theta(R_t - 1)w_t] + \mu_t[\psi_t A_t F_2(k_t, l_t) - \theta R_t w_t]$$

This condition suggests that the marginal cost of increasing labour input has to be equal to the marginal benefit of labour to the household. Combining this equation with the wage rate formula described above and the relationship $\frac{\partial N(l_t)}{\partial l_t} = -\frac{u_2(c_t,l_t)}{u_1(c_t,l_t)}$, we can express the (inverse) labour demand in this economy as follows:

$$w_t = \frac{1 + \frac{\mu_t}{\lambda_t}\psi_t}{1 + \theta(R_t - 1) + \frac{\mu_t}{\lambda_t}\theta R_t} A_t F_2(k_t, l_t) \tag{3.11}$$

Now, we consider the effects of working capital and credit constraint on labour share. In order to see the contribution of each friction, we firstly examine the case in which the upper limit on borrowing is infinitely high, i.e., the agent is not credit-constrained implying that $\mu_t = 0$ for every t. In this case of perfect credit, the expression for labour share follows:

$$s_t = \frac{w_t l_t}{y_t} = \frac{1 - \alpha}{1 + \theta(R_t - 1)} \qquad (\textbf{perfect credit}) \tag{3.12}$$

where s_t is the labour share at period t and α is the capital exponent in the production function. Equation (14) tells us that labour share would still be moving even when the credit market is frictionless since wages deviate from marginal product of labour.[44] An increase (decrease) in interest rates drives the wages to a lower (higher) level than the marginal product of labour which reduces (increases) the labour share of income and increases (decreases) the share of the interest payments in output.

[44] In a decentralized set-up, a similar implication can be derived from firm maximization as in the following:

$$\max_{k_t, l_t} \qquad F(A_t, k_t, l_t) - r_t^k k_t - (1 + \theta(R_t - 1))w_t l_t$$

This maximization problem produces the same labour share as in the equation (6) when Cobb-Douglass production function is taken.

When the credit constraint is introduced, the effect of this mechanism is amplified:

$$s_t = \frac{w_t l_t}{y_t} = \frac{(1-\alpha)(1+\frac{\mu_t}{\lambda_t}\psi_t)}{1+\theta(R_t-1)+\frac{\mu_t}{\lambda_t}\theta R_t} \qquad \textbf{(imperfect credit)} \tag{3.13}$$

Since the increase in R_t is accompanied with credit rationing implying that $\frac{\mu_t}{\lambda_t}$ and R_t are positively correlated to each other, a shock to interest rate will further increase the effective interest rate and influence the labour share more adversely. Intuitively, the demand for labour is lowered not only because of the higher cost of borrowing but also the higher credit restrictions imposed by lenders on firms seeking loans for working capital needs. Note that since labour decisions affect output which tightens or loosens the credit constraint, $\frac{\mu_t}{\lambda_t}\psi_t$ appears in the nominator. However, because $\frac{\mu_t}{\lambda_t}$ and ψ_t are moving in different directions over the cycle, the impact is mostly driven by the denominator.

If a share of income changes, then some other shares have to, as well. We write down incomes of output and explain the changes in the share:

$$y_t = w_t l_t + r_t k_t + \underbrace{\theta(R_t-1)w_t l_t}_{\text{interest payments on working capital loans}}$$

Interest cost on wage bill increases when interest rates rise. In a perfect credit world, capital share remains constant since there is no distortion between capital return and marginal product of capital. Therefore, in the books of national account, labour income share, $\frac{w_t l_t}{y_t}$, falls, and the share of payments to the rest of the world increases. In the presence of leverage constraints, rate of return on capital remains higher than it would be under no binding case; therefore, capital share increases as an immediate response since capital stock cannot change at the time of shock. Thus, the decline in labour share would be higher since both the share of interest payments and of capital income rises.

3.3 Calibration

The equations (3.2)-(3.13) along with the shock processes constitute the system of equations for endogenous variables. These equations are log-linearized, and then solved for the policy functions in terms of endogenous state, $\{k_t, b_{t-1}\}$, and exogenous state variables, $\{A_t, R_t\}$. The model is then calibrated to Mexico quarterly. The sample period is 1987Q1-2008Q4 for which we have the Mexican data. Table 3.1 summarizes the parameter values and Figure 3.2 shows the cyclical pattern of the Mexican labour share with output, which we attempt to explain.

3.3.1 Shocks

We assume that shocks to productivity (in logs) and interest rates (log of *gross* interest rate) are correlated simultaneously such that $\epsilon_t = [\epsilon_t^A, \epsilon_t^R]$ is drawn from an i.i.d normal bivariate distribution, $N(0, \Sigma)$, with zero mean and covariance, Σ. Each shock follows an independent AR(1) process[45]:

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

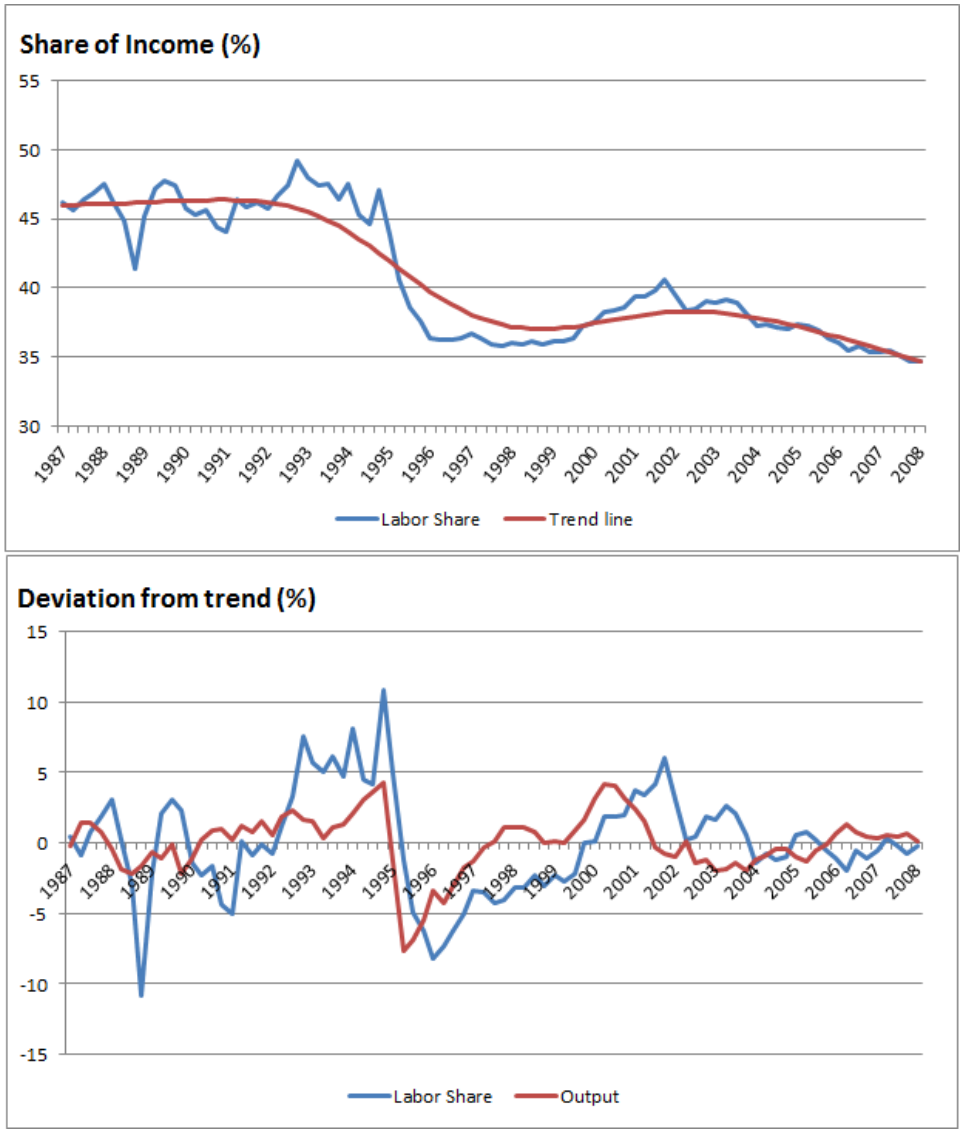
with

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

Solow residuals are used as the measure of productivity. We calculate Solow residuals using Mexican GDP from the OECD: $lnA_t = ln(y_t) - \alpha ln(k_t) - (1-\alpha)ln(l_t)$. Capital exponent is set to match the average labour share (see below) in Mexico. Employment series come from Neumeyer and Perri (2005) and we extend it to 2008Q4 using series at ILO. In order to find total labour input used in production, we calculate total hours by the given

[45] We verified that a VAR estimation of these shocks results in insignificant coefficients for the lags, consistent with results from the previous literature (see, for instance, Mendoza (2010)

Figure 3.2: Labour Share in Mexico



Note: Labour share is at quarterly frequency and seasonally adjusted. It represents total labour cost as a share of manufacturing value-added. Labour cost is adjusted for self-employment. Cyclical components are calculated as percentage deviations from the HP filtered trend. Source: OECD.

Table 3.1: Parameters

Name	**Symbol**	**Value**	**Explanation**
Discount factor	β	0.98	calibrated
Utility curvature	σ	5	Neumeyer and Perri (2006)
Labour curvature	υ	2.75	calibrated
Labour weight	ξ	varies	calibrated
Capital exponent	α	0.43	calibrated
Depreciation rate	δ	0.02	assumed
Wage bill paid in advance	θ	1 or 0.66	assumed
Bond holding cost	κ	0.001	assumed
Capital adjustment cost	ϕ	varies	calibrated
Induced leverage	$\underline{\eta}$	1.82	calibrated
Net Foreign Debt / GDP	$\overline{\psi}$	-0.42	data
Persistence, A_t	ρ_A	0.75	estimated
Persistence, R_t	ρ_R	0.63	estimated
Correlation coef.	$\rho_{\epsilon_A,\epsilon_R}$	-0.45	estimated
Std. deviation, A_t	σ_{ϵ_A}	0.0134	estimated
Std. deviation, R_t	σ_{ϵ_R}	0.0134	estimated

employment series and hours worked in manufacturing from the OECD for Mexico. Capital stock series are constructed using investment perpetual method. Particularly, we set depreciation rate, $\delta = 0.02$ and use the balanced growth path equation, $\frac{(\delta+\gamma)k}{y} = \frac{i}{y}$. Assuming, there is a constant growth rate on the path for the first ten quarters, we find the approximate initial capital stock. Then, we extend the capital stock data using investment series from the OECD. Detrended Solow residuals suggest an AR(1) coefficient of 0.75 and standard deviation of 1.34% of shocks to TFP.

For interest rates, we have two representative series: JP-Morgan EMBI rates and T-bill rates for Mexico. EMBI rates cover only half of the sample. On the other hand, we have T-bill rates for the whole sample period from the IFS.[46] EMBI rates are constructed using JP-Morgan EMBI+ spread data. Since these bonds are denominated by the US dollar, real yields are calculated using the US inflation as in Chapter 2. For Mexican T-bill rates, we use Mexican GDP deflator to obtain real returns. Since the model does not take into account inflation, we subtract the next-period inflation from nominal interest rates to find the (ex-post) real interest rate in Mexico. We note that using different types of expected inflation such as an average of past inflation rates still suggest similar volatility in interest rates. However, we think that using current and/or past inflation in an environment with highly volatile inflation might be fallacious.[47] The behaviour of the cyclical component of domestic interest rates is consistent with Kaminsky et al. (2004). They show that domestic interest rates are volatile and countercyclical in most of the developing countries. We find that both interest rate series have a negative correlation with output above -0.50 in Mexico. In addition, both series share a similar persistence of around 0.60.

Despite the similar comovement between foreign and domestic currency denominated bond rates, the volatility differ dramatically. The quarterly yields from EMBI-constructed detrended interest rates has a standard de-

[46] We take the first two-years observations out of the sample since it represents abnormal changes from -20% to 100% of real return. This is done in order for the results not to be driven by these variations.

[47] We also use the trend portion of the current and/or past inflation and observe that the results on shock parameters do not change much.

viation of 0.44%. On the other hand, domestic interest rates are more than four times volatile: 2.01%. This difference is mainly due to the exchange rate risk. Indeed, previous literature on emerging market crises emphasize the burden of the foreign-currency denominated debt as these countries experience sharp depreciation during their economic slowdowns. Therefore, lending to emerging economies in their own currency is risky. And similarly, borrowing in foreign currency is risky in the eyes of firms in emerging markets as this increases debt service during the periods of falling output because of depreciation (Calvo (1988), Gumus (2005), Jeanne (2003), Krugman (1999)).[48] Since our model does not include monetary terms in it, assuming a low volatility of rates will overpredict the effect of imperfect credit. Given large volatility difference, we assume that shocks to interest rates have the same volatility as productivity shocks, that is equal to 1.34%. This corresponds to a number within the range of deviations observed in those two series.[49] The correlation between shocks to TFP and interest rates is estimated to be equal to -0.45 using foreign rates.[50]

For the stochastic leverage ratio, we set η in equation (8) to be 1.82 so that the standard deviation of ψ_t matches the standard deviation of credit-to-gdp ratio for the private sector over the sample period (See Figure 3.3 for the cyclical properties of the credit-to-GDP ratio in Mexico.) This number suggests that debt-to-income rule increases by 1.82% when quarterly interest rates rise by 1%.

3.3.2 Other Model Parameters

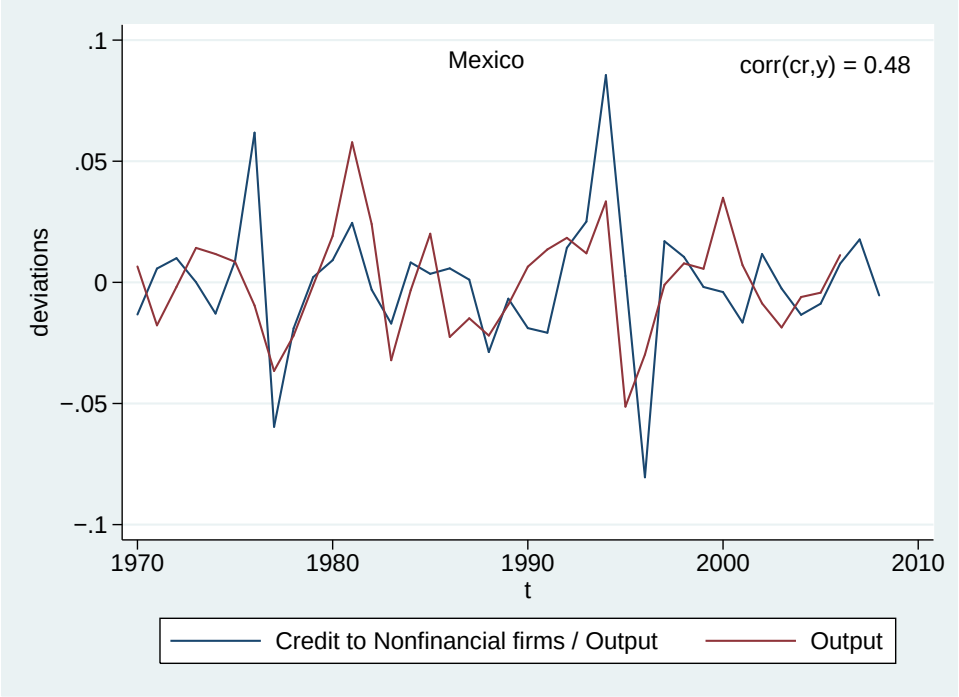
Using the average interest rate level and depreciation rate, we extract the values for discount factor and steady-state shadow price of credit constraint simultaneously from optimal bond holding and capital equations at steady state. Calculations result in $\beta = 0.98$ and $\frac{\overline{\mu}}{\lambda} = 0.01$. Capital exponent

[48] Moreover, Kaminsky et al. (2004) show that monetary policies are pro-cyclical with output in emerging markets. These policies (such as increasing nominal interest rates to prevent capital outflows) might have an impact on real interest rate.

[49] It is close to other parameter values used in the literature for the deviation of interest rates. See Mendoza (2010) and Li (2011).

[50] The estimated correlation coefficient is -0.48 when T-bill rates are used.

Figure 3.3: The Cyclical Component of the Credit-to-GDP Ratio in Mexico



Note: Credit represents total domestic credit to nonfinancial firms (i.e. private credit). Deviations are in percentage points from the HP filtered trend.

is calibrated to match the average labor share in Mexico over the sample period, i.e.,

$$\frac{1-\alpha}{1+\theta(\overline{R}-1)} = 0.57.$$

The equation shown above implies $\alpha = 0.43$ when $\theta = 0.66$[51]. The labour share using the National Account data is very small (around 0.33) since it suffers from measurement problem such as informal employment and self-employment labour income. Labour compensation data from National Account usually come from the formal sector in developing countries. The data on the contribution of informal sector to Mexican GDP from 1993-2004 are available. Informal sector contributes 12.4% of value added GDP on average. Adjusted share is obtained first by correcting official labour compensation data using this contribution of the informal sector. The implicit assumption here is that labour content is the same across formal and informal sectors.[52] Then, we further adjust it to account for the labour income of the self-employed people using the self-employment ratio in Mexico, which is close to 33% of the total employment (see Figure 3.4 for unadjusted and adjusted labour share as well as the labour share in different sectors of the economy). This implies the average labour share over this period to be equal to 0.57, a number closer to that in developed economies.

The functional form for the utility function is the following:

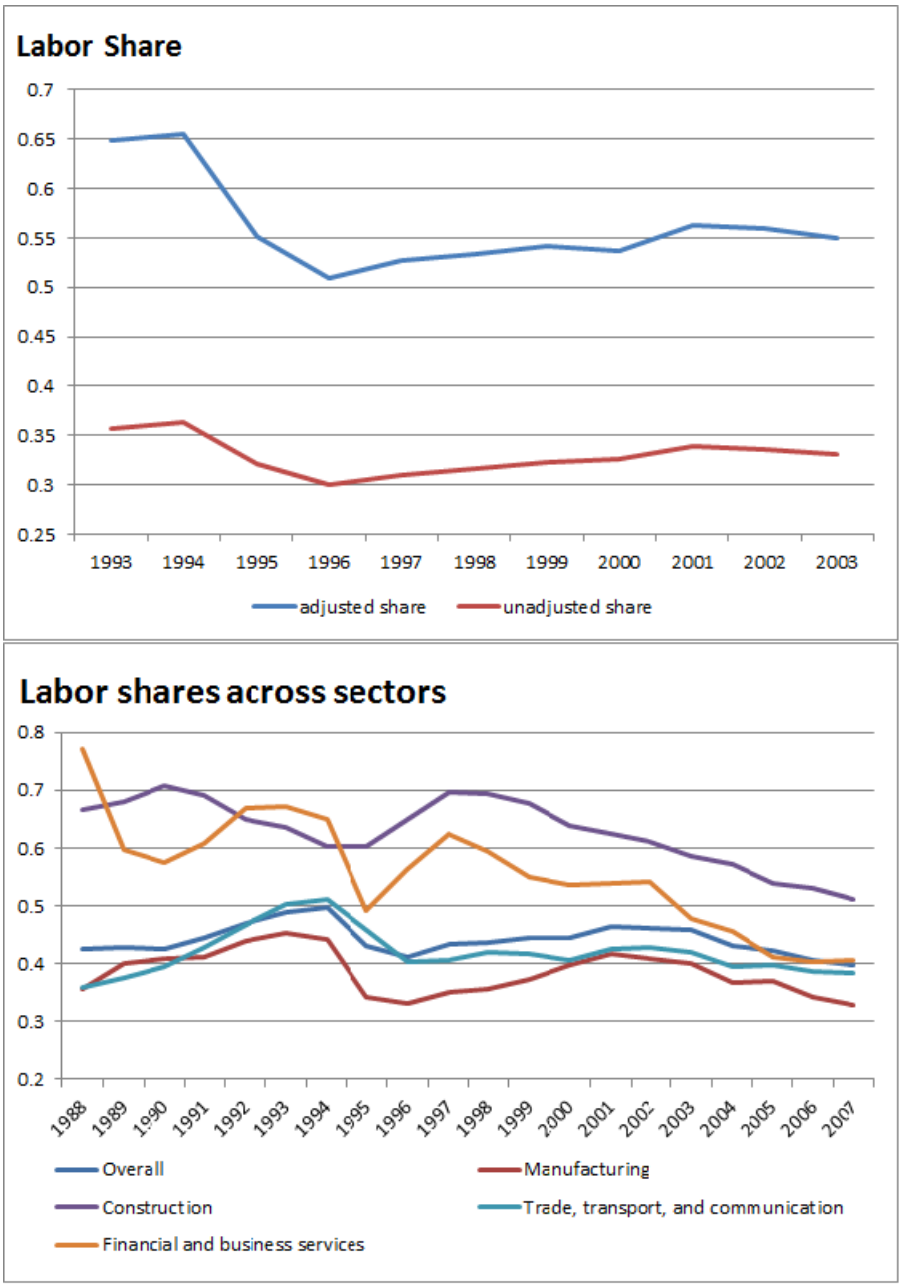
$$u(c_t, l_t) = \frac{1}{1-\sigma}[c_t - \xi l_t^{\upsilon}]^{1-\sigma} \tag{3.14}$$

Intertemporal elasticity of substitution is set to 0.2, which implies $\sigma = 5$ following Neumeyer and Perri (2005), who use the same preferences as in this chapter. Using the optimal labour supply equation at the steady state, labour weight parameter ξ in the utility function is set to match $\bar{l} = 0.32$ which is the fraction of hours worked in the total non-sleeping hours. The

[51] Capital exponent is equal to 0.42 when $\theta = 1$

[52] Note that one can imagine a higher labour share for informal sector. A higher share, say 20% higher labour share than in the formal sector, increases the level of labour share in the overall economy by only a couple of percentage points since informal sector's contribution is smaller in value. In terms of volatility, a higher share in the informal sector would actually make the labour share more volatile because the informal sector is pro-cyclical.

Figure 3.4: Adjusted Labour Share and Sectoral Shares in Mexico



Note: Adjusted share is annual and obtained by first scaling official labour compensation data using the contribution of the informal sector to the value added. The implicit assumption here is that labour content is the same across formal and informal sectors. Then, the share is further adjusted for self-employment to account for the labour income of the self-employed. The sectoral shares are adjusted only for self-employment. *Industry* represents mining and quarrying, manufacturing, electricity, gas and water supply, and construction. *Private Sector* covers all the sectors excluding the public sectors, such as health, education, and administration. Source: OECD, INEGI.

total hours worked time-series in manufacturing from OECD-MEI dataset is used in the calculation of the steady state value of hours, $\bar{l}$. In the model, υ determines the Frisch elasticity of labour supply, $\frac{1}{\upsilon-1}$. The empirical evidence on this parameter is mostly coming from developed markets and the values used in the literature are in the range [0.5,1]. Considering their lower income and wealth, we assume that agents in emerging markets stand closer to lower bound of this range and set the value of υ to 2.75 showing an elasticity of labour, 0.57, which implies a standard deviation of hours closer to data. Although this parameter is not crucial for the results on labour share fluctuations, it changes how the movements in the wage bill are split between the labour input and hourly wages. Finally, we calculate the net foreign asset held by households at the steady state as the average over the sample period using the dataset on countries' external asset positions from Lane and Milesi-Ferretti (2007).

3.4 Results

Figure 3.5 presents the impulse responses from models with perfect and imperfect credits. Table 3.2 further contains the volatility implications of different versions of the calibrated model along with the second moments from data. Details on data along with sources can be found in Appendix B The data moments represent quarterly variations after taking logs (except net export-GDP ratio and net interest rate) and HP-filtering that sets the smoothing parameter to 1600.[53] Quarterly labour share data in manufacturing are used as a proxy of overall labour share fluctuations in the economy (see Figure 3.2). We check that, at the annual level, series from both manufacturing and total economy are highly correlated to each other (0.86) and have large standard deviations of 4.5% and 3.5% in the manufacturing and overall economy, respectively. The second column lists the moments from the standard SOE-RBC model for comparison, and the remaining columns document the results of the model described above in both cases of perfect

[53] ARIMA-X12 from the Census Bureau is applied to deseasonalize data when there are significant seasonal effects.

and imperfect credit markets for different values of the working capital parameter.

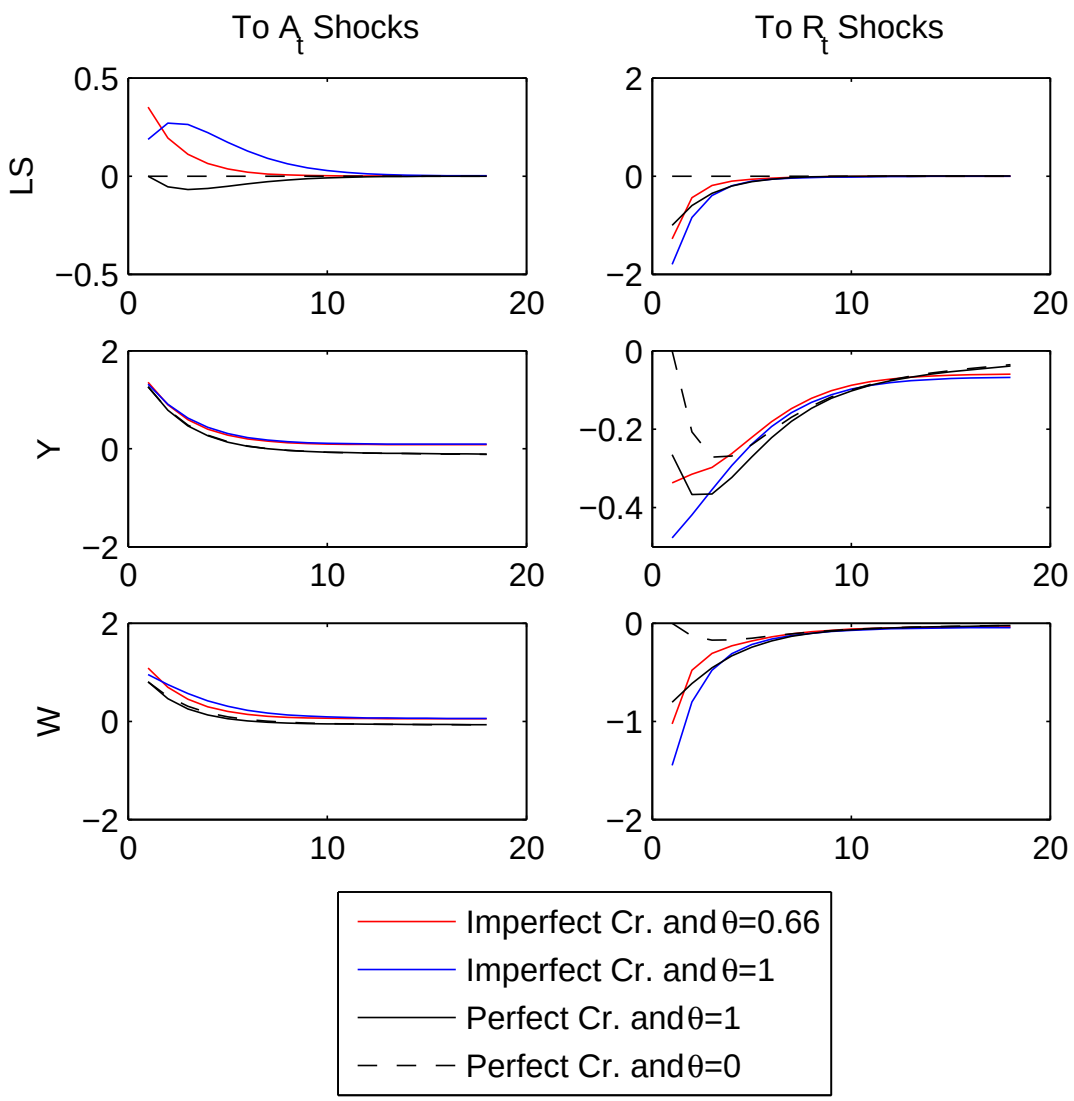
SOE-RBC Model. To begin with, the results from the standard SOE-RBC model cannot generate any movements in labour share because the Cobb-Douglass production technology implies a constant labour share in a competitive environment where wage is equal to the marginal product of labour. Consequently, it cannot account for the volatility in labour market variables. As mentioned earlier, real wages are more volatile than output in emerging markets, but even with the relatively inelastic labour supply assumed, SOE-RBC is having a hard time explaining highly volatile wages.

One of the most distinguishable characteristics for fluctuations in emerging markets emphasized earlier in the literature is that they have highly volatile and cyclical consumption and net exports to GDP ratio. The standard model also fails to adequately explain these features in emerging markets since agents tend to smooth their consumption using credit markets when the shocks are temporary.[54]

The Model with Working Capital and Perfect Credit. We now continue with the implications from the model with working capital in an environment with perfect credit. These results are reported in the third column in Table 3.2. The introduction of working capital without any limits on borrowing can generate variations in labour share. Because interest rates are countercyclical, working capital requirement tends to produce a larger response in labour demand than in the standard SOE-RBC model. As a consequence, it can be seen that wages and hours become more volatile in these models. Having a more volatile wage bill results in a procyclical labour share consistent with the data. Although the model could predict the movements of labour share with output, the volatility depends heavily on

[54] Aguiar and Gopinath (2007) show that the standard model can explain these features when non-stationary shocks are introduced to the model. However, recently, Garcia-Cicco et al. (2010) estimate that these shocks have a negligible role in emerging market business cycles.

Figure 3.5: Impulse Responses



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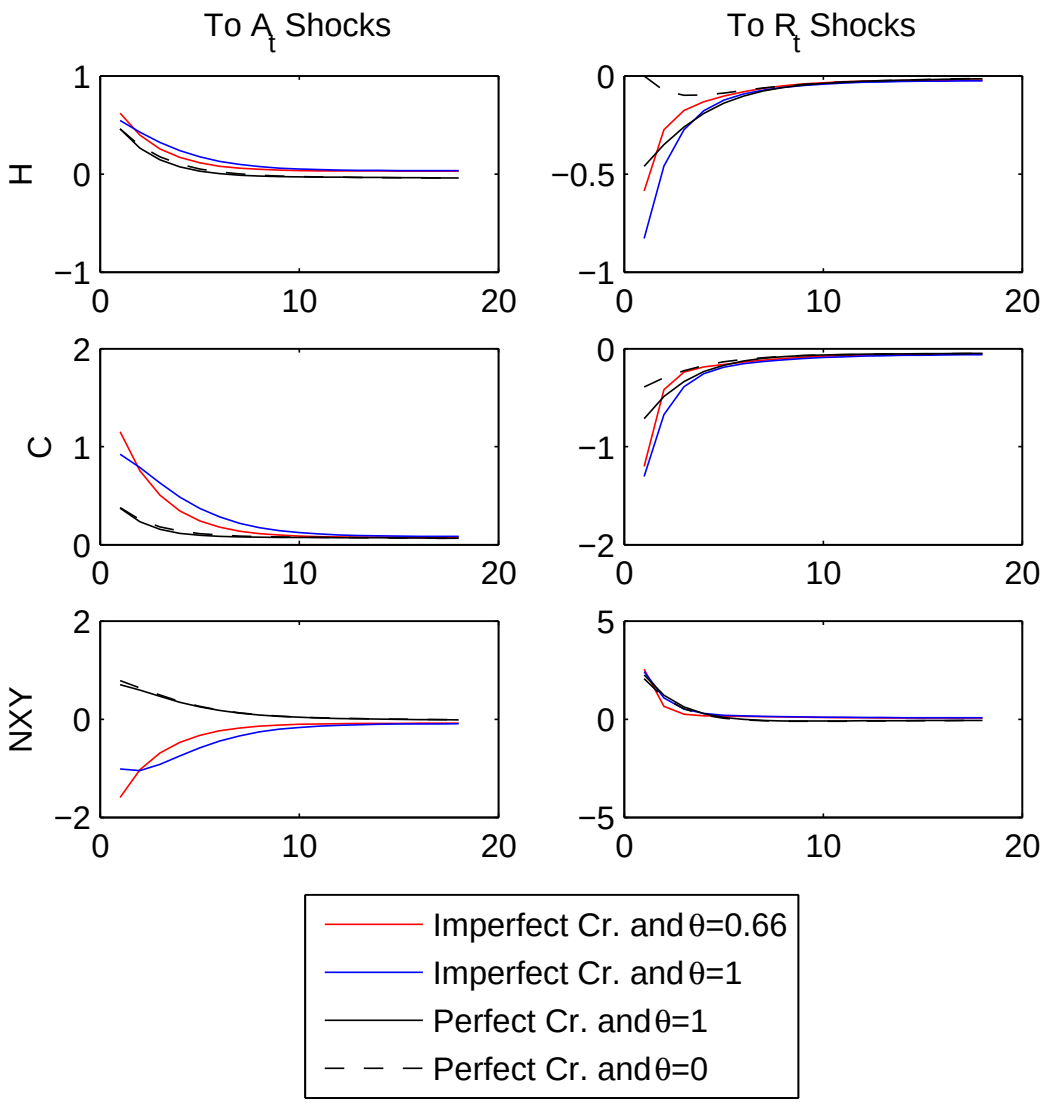

To A_t Shocks
To R_t Shocks
H
C
NXY
Imperfect Cr. and θ=0.66
Imperfect Cr. and θ=1
Perfect Cr. and θ=1
Perfect Cr. and θ=0

Table 3.2: Model Implications for Mexico

			θ=1		θ=0.66	
	Data	**RBC**	**Perfect Credit**	**Imperfect Credit**	**Perfect Credit**	**Imperfect Credit**
Standard Deviation						
Output	2.19	1.95	2.14	2.30	2.07	2.25
Labour share	**3.58**	**0.0**	**1.68**	**2.62**	**1.12**	**2.13**
Net exports	2.25	1.80	1.89	1.67	1.85	2.01
Standard Deviation (Relative)						
Wage	1.82	0.64	0.95	1.25	0.83	1.14
Hours	0.64	0.36	0.54	0.71	0.47	0.65
Consumption	1.35	0.56	0.69	1.08	0.65	1.28
Investment	3.45	3.45	3.45	3.45	3.45	3.45
Correlation with Output						
Labour Share	**0.44**	**0.0**	**0.52**	**0.68**	**0.48**	**0.68**
Interest Rate	-0.53	-0.39	-0.52	-0.59	-0.48	-0.55
Wage	0.41	1.0	0.93	0.90	0.95	0.92
Hours	0.64	1.0	0.93	0.90	0.95	0.92
Consumption	0.89	0.87	0.86	0.92	0.86	0.91
Investment	0.94	0.30	0.46	0.91	0.41	0.88
Net Exports	-0.65	0.43	0.24	-0.56	0.30	-0.58
Lab. Share and R	-0.48	0.0	-1.0	-0.89	-1.0	-0.86

Note: Data period is 1987Q1-2008Q1. All variables are in logs (except net interest rate and net export) and HP-filtered. Quarterly labour share and wages are coming from manufacturing but labour shares in manufacturing has a very strong correlation with labour share in overall activity at annual level. Investment adjustment cost parameter is set to match investment volatility. Net export is defined as exports minus imports over output. The last line represents the correlation between labour share and interest rates.

the working capital parameter, θ. The results from the model with a lower working capital requirement can be seen in the fifth column. A smaller value for this parameter significantly lowers the volatility of labour share.

Although they predict some of the volatility in labor share, the models with perfect credit can explain neither the strong countercyclicality in net exports-GDP ratio nor the strong procyclicality in investment. As a result, consumption tends to be less volatile than output. This is because under relatively less persistent shocks, investment is less cyclical with current output and the smoothing behaviour still appears. Consequently, net exports become procyclical (or acyclical) in the perfect credit market. These results are different from the ones in Li (2011) where she generates these features in a model with working capital and perfect credit. One reason might be the lower elasticity of the intertemporal substitution set here. However, consumption is still not more volatile than output when using the same parameter value as in her paper. Another reason is that the interest rate shocks in her paper are twice as volatile as TFP shocks, whereas they are just as volatile as TFP shocks here.

The Model with Working Capital and Imperfect Credit. Finally, the results from the model with leverage constraint can be seen in columns 4 and 6. An imperfect credit market makes labour share more volatile compared to the case with perfect credit thanks to more volatile wages and labour input. Now, the model can explain 73% of the variations in the Mexican labour share assuming $\theta = 1$. Moreover, even with a lower working capital parameter (as shown in column 6), the model can explain a significant part of the volatility in labour share (60% of the variations in labour share). Therefore, the presence of borrowing limits allows us to set a lower working capital requirement than that used in the literature. This is quite reasonable especially when one considers that, in some industries, working capital might be of less importance.

Imperfect credit not only increases the volatility in the labour market, but also significantly improves the implications on the fluctuations of consumption, investment, and net exports over the cycle. When the leverage

constraint is introduced, which makes financing even more difficult, smoothing behaviour disappears. Therefore, consumption becomes more volatile than output, and investment becomes strongly procyclical with output. As a result, the net export-GDP ratio moves inversely with output over the cycle consistent with data.

We also note that all models presented here imply very procyclical wages. However, wages are somewhat lower cyclical (0.45) in data. This smaller cyclicality is a well-known fact in developed markets as well.[55] Wage rigidities through contracting models (see Gomme and Greenwood (1995)) and the change in skill composition of labour (see Bils (1985)) over the cycle may make aggregate wages less cyclical.[56] In addition, search-and-matching frictions in labour market can also contribute to explain wage movements less cyclical than models with frictionless labour market predict, which is further discussed in Chapter 4.

3.5 Implications for Developed Economies

In this section, we show the performance of the model in a developed market. We calibrate the model to Canada, and then compare and contrast the results with the implications for Mexico. The model with imperfect credit market and a working capital requirement of 0.66 is taken as the baseline in this section.

As mentioned earlier, the literature suggests mechanisms for the countercyclicality of labour share in developed markets through less responsive wage bill to output changes. High unionization (especially in Europe), firing and search costs, and contractual labour market imply sluggishness either on wages or on the quantity of labour.[57] Based on these explanations, for

[55] See Ríos-Rull and Choi (2009) and Li (2011) for the recent wage-output correlations in the US and other developed markets.

[56] Introducing these features into the model will, in fact, increase the importance of working capital and the countercyclical cost of borrowing. This is because those features tend to lower the volatility of wages in models, and thus work in the opposite direction of working capital.

[57] There are also other explanations for the countercyclicality of labour share in developed markets. Hansen and Prescott (2005) introduce occasionally binding capacity

a representation of labour market rigidities, we include an adjustment cost on labour to understand how they interact with working capital and contribute to the variability of labour share. These rigidities or regulations in the labour market can be expected in emerging markets, as well. Heckman et al. (2000), for example, show that employment protection is high in Latin American countries.[58] Therefore, by having adjustment costs on labour, we would also like to see how they alter the results of the baseline model in emerging economies explained in the previous section. A convex labour adjustment cost is introduced to the model as follows:

$$\Omega(l_t, l_{t-1}) = \phi_l l_{t-1}(\frac{l_t - l_{t-1}}{l_{t-1}})^2$$

This cost has a significant effect on the autocorrelation of hours worked. Therefore, ϕ_l parameter is set to match the autocorrelation of hours in data which is 0.69 and 0.66 in Mexico and Canada, respectively. For other parameters in the calibration of the Canadian economy, we follow similar approaches done for Mexico above except that we assume a higher labour elasticity (unit elasticity as in the literature) and a lower η representing a higher level of financial development in Canada. Other parameters for Canada along with Mexican counterparts can be found in Appendix B

The results can be seen in Table 3.3. The first columns for each country represent data moments.[59] The baseline model, when calibrated to Canada, can generate a countercyclical labour share since interest rates are slightly procyclical in Canada. In response to a positive productivity shock, higher interest rates mitigate the response of labour demand and wage bill to output producing a countercyclical labour share. However, since interest rates do not vary much, the model can only explain a small part of the volatility in labour share in Canada.

On the other hand, the modified version of the model with the adjust-

constraints implying procyclical capital share, and consequently countercyclical labour share with output.

[58]Moreover, the OECD protection index also indicates that Mexico and Turkey have much more protection on labour than the average of that among OECD countries.

[59]Refer Appendix B for data details on Canada

Table 3.3: Model Implications for Mexico and Canada

	Mexico			Canada		
	Data	**Baseline**	**Sluggish Labour**	**Data**	**Baseline**	**Sluggish Labour**
Standard Deviation						
Output	2.19	2.25	2.28	1.30	1.02	0.92
Labour share	**3.58**	**2.13**	**1.67**	**1.05**	**0.19**	**0.31**
Net Exports	2.25	2.01	2.25	0.88	0.21	0.27
Standard Deviation (Relative)						
Wage	1.82	1.10	1.14	0.64	0.49	0.40
Hours	0.64	0.65	0.65	0.65	0.49	0.40
Consumption	1.35	1.28	1.22	0.72	0.44	0.37
Investment	3.45	3.45	3.45	2.55	2.55	2.55
Correlation with Output						
Labour Share	**0.42**	**0.68**	**0.53**	**-0.62**	**-0.19**	**-0.73**
Interest Rate	-0.45	-0.55	-0.49	0.33	0.25	0.25
Wage	0.41	0.92	0.92	-0.20	0.99	0.95
Hours	0.64	0.92	0.92	0.81	0.99	0.95
Consumption	0.89	0.91	0.83	0.69	0.99	0.95
Investment	0.94	0.88	0.72	0.72	0.96	0.95
Net Exports	-0.65	-0.58	-0.30	0.07	0.55	0.68
Labour Share and R	-0.48	-0.86	-0.89	-0.15	-0.94	-0.12

Note: Baseline model is the one with imperfect credit and $\theta = 0.66$. Third and sixth columns add adjustment cost on labour to baseline model. For other details see table 3.2.

ment cost on labour can explain more variation in the labour share. Sluggish labour makes the wage bill less responsive to output, and contributes to the cyclicality and volatility of labour share as the previous works in the literature suggest. Therefore, working capital and labour market rigidities work in the same direction in explaining the movements of labour share in developed markets. Since the interest rates in developed markets are not volatile, the effect of working capital is minimal. However, emerging markets serve as a good natural experiment with their different behaviour of interest rates. In the model economy for the emerging market, introducing labour market rigidities cannot offset the effect of working capital on labour share because interest rates are much more volatile than in developed markets. Without working capital, labour share becomes negatively correlated with output, which is counterfactual. This suggests that working capital is the predominant factor in determining the movements of labour share in emerging markets.

3.6 Conclusion

In this chapter, we attempt to explain labor share fluctuations in emerging markets, namely highly volatile and procyclical labor share. We explore the effect of financing labour, and show that working capital can be a good mechanism generating fluctuations in labour share consistent with the data. The liquidity need for labour payments imposes a burden on the cost of labour, and leads to a more (less) responsive wage bill when interest rates are countercyclical (procyclical) with output. Since interest rates in different country groups move in opposite directions over the cycle, the effect of cost of borrowing varies across these groups implying a procyclical labour share in emerging markets, and a countercyclical one in developed markets. Introducing other financial problems that emerging economies encounter, such as credit frictions, amplifies the results by making the effective interest rate more volatile than the observed one. Binding leverage constraints not only contribute to the variability in labour share but also improve the model performance in terms of other business cycle regularities in these economies,

such as highly volatile consumption, strongly countercyclical net exports, and procyclical investment.

Following the literature on labour share in developed economies, we also include an adjustment cost on labour as a representation of the slow adjustment in the labour market. Without working capital, these models tend to produce counterfactual labour share fluctuations in emerging markets by making wage bill less responsive to output. Nonetheless, they can contribute to labour share fluctuations in developed markets. In short, financing labour income plays an important role on labour share movements in an environment with unstable financial markets associated with highly volatile costs of borrowing. On the other hand, labour market rigidities generating less responsive wage bill are more likely to be pronounced than working capital channels in countries where financial markets are stable. We leave for future research the task of analyzing the interaction between endogenous rigidities specific to labour market and financing wage payments.

Chapter 4

Search Frictions, Financial Frictions, and Labour Market Fluctuations in Emerging Markets[60]

4.1 Introduction

A number of recent papers have drawn attention to the stylized facts of business cycles in emerging market economies. In such economies, consumption is highly volatile and fluctuates more than output while net exports are strongly countercyclical. Among other papers, Aguiar and Gopinath (2007) attempt to reconcile these findings in the context of a small open economy real business cycle model (SOE-RBC). They argue that for emerging markets, the cycle is the trend in that fluctuations in trend productivity can account for many of the business cycle features. Neumeyer and Perri (2005) introduce countercyclical financial or interest rate shocks in emerging economies through a working capital requirement as a propagation mechanism. Another difference between developed and emerging economy business cycles has to do with the behaviour of labour market variables. In contrast to developed economies, real wages are highly volatile and procyclical in such economies, as is the labour share. Boz *et al.* (2009) examine a model with search frictions to account for the labour market findings while Li (2011) and

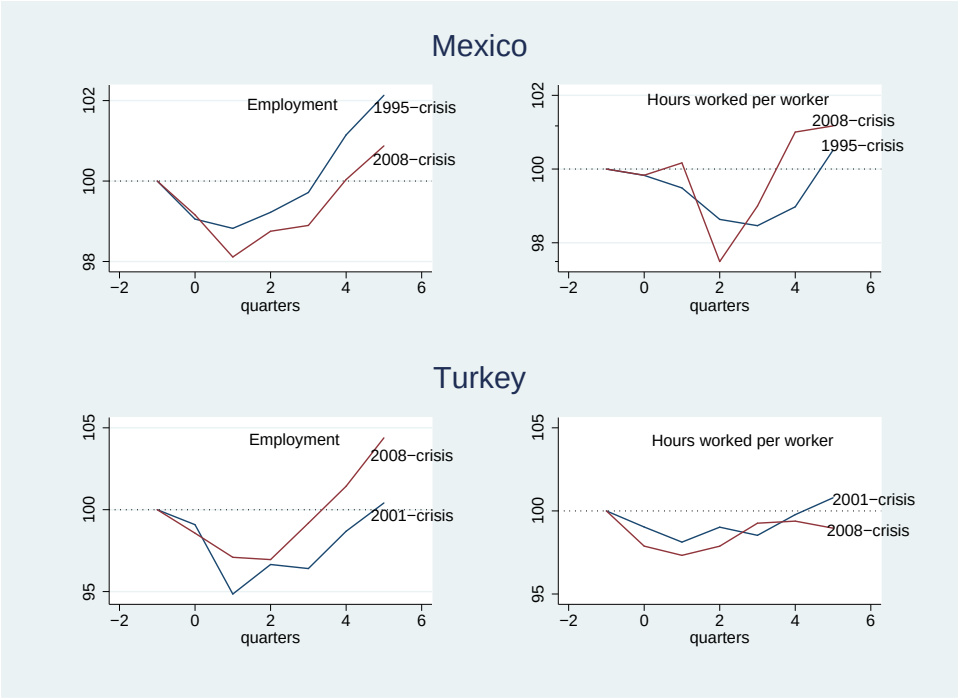
[60]This chapter benefited from discussions with Sumru Altug, and has become a joint work with her.

Chapter 3 of this dissertation seek to rationalize the movements in wages and labour share with financial frictions in a Walrasian labour market setup.

This chapter contributes to this literature by examining variations in different margins of labour input: employment (the number of people employed) and hours (worked) per worker. Our motivation for different margins of labour input stems from the significant variation observed not only in employment but also hours per worker in emerging markets. Figure 4.1 shows that employment in countries such as Mexico and Turkey fell after the crises they experienced, and remained below pre-crisis levels for more than a year. Moreover, hours per worker in these countries displays a U-shaped pattern, too, first declining and then rising over the course of these crises. Not surprisingly, these countries experienced increased spreads on their borrowing rates relative to other developed economies and faced difficulties in accessing funds on the international capital markets, as discussed in Chapter 3. In our explanation, this behaviour of the cost of borrowing will play a role to explain the joint comovement between different margins of work.

We begin by showing that the variations in the intensive margin of labour (or hours per worker) relative to those in the extensive margin (employment) are more significant in emerging markets than in developed markets. Furthermore, both hours per worker and employment are positively correlated with output and with each other in emerging economies whereas hours per worker is less cyclical with output and not significantly correlated with employment in developed markets. While changes in employment have been examined in the context of search models for emerging economies, previous work has essentially ignored changes in the intensive margin. We propose a SOE-RBC model that allows for both extensive and intensive margins in the total hours choice and analyze its implications on cyclical properties of labour market variables such as hours per worker, employment and real wages, and goods market variables such as consumption and net exports. The model incorporates a financial friction in the form of a working capital constraint and search frictions in the labour market. The financial friction is motivated by the fact that most firms in emerging economies finance cur-

Figure 4.1: Employment and Hours Per Worker during Crises



Note: Data is quarterly and seasonally adjusted. Period zero is the quarter when the crisis starts. The value in one quarter before crisis started is scaled to 100.

rent operating costs through short-term bank credit.[61] In our framework, a search-and-matching friction accounts for fluctuations in the extensive margin of work, while Nash bargaining between workers and firms accounts for variation in the intensive margin along with wages.

Our findings suggest once we allow for an endogenous intensive margin, a search-theoretic framework cannot reconcile business cycle puzzles for emerging economies. This is due to a strong income effect on hours worked, which tends to move supply of labour in the same direction as interest rates, thereby generating counterfactual results for hours and consumption. These results are only partially corrected when we utilize alternative forms of preferences which imply a smaller income effect (see Jaimovich and Rebelo (2009)). While search models yield a large response of wages

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

to the exogenous shocks in the absence of an endogenous hours choice (see Boz et al. (2009), the smaller income effect tends to lessen this response in the presence of the endogenous hours choice. It is by allowing for financial frictions in the form of a working capital requirement that we can explain the labour market fluctuations. Working capital also generates slightly better predictions on consumption and net exports.Specifically, the working capital requirement tends to amplify the impact of interest rates that work through labour demand, in that a higher interest rate depresses the demand for labour and reduces the hours of work and vacancy postings. Our findings suggest that there are interactions arising from financial and search frictions in SOE-RBC models that jointly rationalize the observed responses of the labour market outcomes together with key macroeconomic time series.

This chapter is related to the literature that previously studied the role of search frictions on aggregate fluctuations in developed markets as well. Andolfatto (1996) and Merz (1995) show that these types of frictions have an amplification effect on labour market variables in closed-economy business cycle models. Hairault (2002) considers the case of two large open economies with search and matching frictions. There are also studies that stress the role of differentiating between the intensive and extensive margins in the context of search models for developed economies. Yedid-Levi (2009) and Merkl and Wesselbaum (2011) show that hours per worker is a secondary source of variation in developed economies. Yedid-Levi (2009) further argues that differentiating the different margins of labour is an essential step for understanding the comovements across sectors in a model with search and matching frictions. In a different vein, using a time-varying vector autoregression framework, Seymen (2011) examines the role of the extensive versus intensive margins of work in the US and Germany so as to explain the adjustment to cyclical shocks. In a recent paper, Petrosky-Nadeau (2011) combines search frictions with credit imperfections and show that, in a developed market, incentive to hire during credit tightening is lower given the same benefit to the worker.[62]

[62] We do not introduce imperfect credit in this chapter so as to concentrate on the interaction between search and working capital loans.

Literature on intensive margin of labour across developed markets concentrates on the the role of labour market regulations. Studies such as Burdett and Wright (1989) show that different unemployment compensation schemes may lead to differential responses in employment versus hours per worker. Specifically, a scheme that allows for partial compensation when hours are reduced – as practiced by many European economies – may yield larger variations in the intensive margin relative to a US-type scheme in which workers are compensated conditional on being employed or not. In Section 2, we also discuss the labour regulation in emerging markets using dataset constructed by Botero et al. (2004), and show that despite their regulatory resemblance with European countries, the movements of labour margins differ those in Europe. This is why, rather than different institutional frameworks, we study the effect of different financial environment emerging markets face, such as the higher cost of borrowing during recessions, on margins of labour input.

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

4.2 Fluctuations in the Intensive and Extensive Margins of Labour Input in Emerging Markets

In this section, we present some evidence regarding variation in the labour input in emerging economies due to the intensive and extensive margin of work. We have data, mostly over the period of 1981-2008, on both margins of labour input in manufacturing for a set of emerging and developed countries. The data on hours come from industrial surveys in emerging market

economies.[63] Hours represent actual hours worked in these surveys, which is consistent with both national accounts in these economies and the OECD data for developed economies. Data description and sources are explained in the Appendix C.

We detrend the data using HP-filtering. Since the data is annual, the smoothing parameter is set to be equal to 6.25. The cyclical properties of both margins of labour input are presented in Table 4.1. Specifically, Table 4.1 shows the standard deviation of employment and hours per worker as a fraction of the standard deviation of real output, the correlation of output with employment and hours per worker as well as the correlation of employment and hours per worker in both emerging and developed economies.

One of the interesting findings from Table 4.1 is that the relative standard deviations of employment and hours are reversed for emerging versus developed economies. In the developed economies, the variability of employment relative to that of GDP is greater than the variability of hours per worker relative to that of GDP for almost all countries except Austria, Finland, and Germany. The average value of the relative standard deviation of employment is 0.92 versus 0.59 for hours per worker in developed economies. By contrast, the difference is not significant for the emerging economies. The average value of the relative standard deviation in employment is 0.59 versus 0.64 for hours per worker in emerging economies.[64] This suggests that labour market behaviour in emerging economies features significant variation in the hours per worker in addition to changes in em-

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

[64] Note that the volatility of the intensive margin might be even higher than presented here for both groups when we allow for labour utilization, since the effort that each worker puts in during recessions may be lower than in boom times.

Table 4.1: Movements in Employment and Hours Worked Per Worker

	$\frac{\sigma(e)}{\sigma(y)}$	$\frac{\sigma(h)}{\sigma(y)}$	$\rho(e,y)$	$\rho(h,y)$	$\rho(e,h)$		$\frac{\sigma(e)}{\sigma(y)}$	$\frac{\sigma(h)}{\sigma(y)}$	$\rho(e,y)$	$\rho(h,y)$	$\rho(e,h)$
EMs						DMs					
Argentina	0.54	0.42	0.83	0.60	0.86	Austria	0.51	0.92	0.68	-0.32	-0.66
Brazil	0.72	1.09	0.35	0.57	0.27	Canada	0.71	0.40	0.88	0.43	0.35
Columbia	0.51	0.18	0.39	0.36	0.56	Denmark	0.74	0.73	0.73	0.22	-0.01
Czech Rep.	0.46	0.70	0.44	0.17	-0.61	Finland	0.40	0.81	0.83	0.56	0.12
Hungary	1.01	0.74	-0.03	0.07	0.33	France	1.15	0.92	0.62	-0.08	-0.36
Korea	0.67	0.47	0.93	0.77	0.60	Germany	0.36	0.53	0.68	0.06	-0.06
Mexico	0.41	0.16	0.73	0.63	0.68	Italy	1.01	0.59	0.45	0.46	0.15
Turkey	0.41	1.32	0.55	0.59	0.03	Norway	0.99	0.63	0.54	0.31	-0.16
Average	**0.59**	**0.64**	**0.52**	**0.47**	**0.34**	Spain	1.34	0.56	0.98	0.12	-0.03
						Sweden	0.86	0.86	0.47	0.39	-0.20
						U.S.	0.98	0.64	0.87	0.66	0.38
						Average	**0.82**	**0.69**	**0.68**	**0.26**	**-0.04**

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

ployment.[65] A second finding from Table 4.1 is the significantly higher correlation of detrended real GDP with hours per worker for the emerging economies. We observe that this quantity is nearly twice as large as that in developed economies. Furthermore, the variation is due to countries such as Argentina, Korea, Mexico and Turkey, where we have typically observed large financial shocks and financial crises in the period since the 1980s or 1990s.[66]

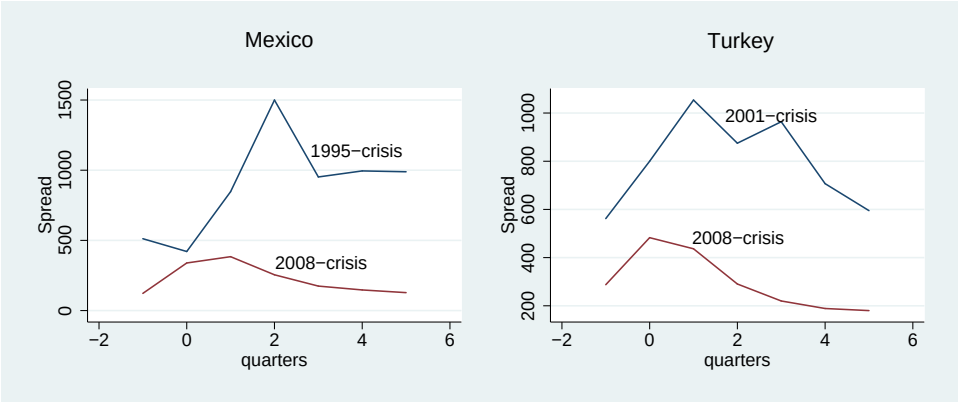
A third finding from Table 4.1 is that the correlation between employment and hours per worker is also positive in emerging economies and much larger than that for the developed economies. On the contrary, there is a negative correlation between employment and hours per worker for many of the European economies such as Austria, France, Germany, Norway, and Sweden.[67] These results suggest that the dynamics of labour markets in emerging economies may differ in significant ways from those of developed ones. The difference is even more striking when we take into account institutional comparisons. Botero et al. (2004) present a dataset on employment protection laws across countries (see Appendix C for a plot of employment protection indices across countries examined here). In this dataset, the average employment protection index is 0.45 in emerging markets, a value between the average index for the US and Canada (0.24) and that for European countries (0.67). Yet, emerging economies show even stronger cyclicality of hours per worker with output and stronger comovement between intensive and extensive margins than the Anglo-Saxon countries such as Canada and

[65] Since manufacturing industry tends to be more volatile than the aggregate economy, standard deviations of hours per worker for the latter might be lower than presented here. Nevertheless, these results still suggest that the variation in the intensive margin relative to the extensive margin is more important in emerging markets than in developed ones.

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

[67] As discussed in Introduction, one reason for the negative correlation between employment and hours in European economies may be the existence of employment protection laws.

Figure 4.2: Spread during Crises



Note: CDS data are used for 2008 spreads. This dataset start only after 2002. For earlier crises, we used JP-Morgan EMBI+ spreads from Uribe and Yue (2006) dataset. Period zero is the quarter when the crisis starts.

the US in our sample. That is why, rather than institutional differences, we focus on financial differences these countries face over their business cycles. As we will show subsequently, financial shocks (countercyclical interest rates) can turn out to be the reason behind such significant comovement of hours per worker with both output and employment when we allow for a friction in the form of a working capital requirement for firms.

In addition to annual data, we present evidence from quarterly data as well. Figure 4.1 plots the movements of the hours per worker and employment in Mexico and Turkey during both the recent global crisis and their own domestic financial crises. The starting dates of domestic crises are 1994Q4 and 2001Q1 for Mexico and Turkey, respectively. In addition, 2008Q4 is chosen to be the starting period for the recent global crisis for both countries. These are the quarters when GDP declined for the first time after a series of quarters with positive growth.[68] The evidence from quarterly data supports the findings using annual data. In particular, Figure 4.1 shows that both margins of labour input tend to move similarly, and follow a U-shape during both crises. Thus, both drop when output drops,

[68] Krugman (1999) also reports 1994Q4 to be the starting period for the balance-of-payment crisis in Mexico.

Table 4.2: Correlation between Spread and Labour in Emerging Markets

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

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

and begin to improve after a couple of quarters.

One of the interesting features during periods of fallen output is that both countries have tended to experience difficulties in financing their external balances. During earlier domestic crises, increases in sovereign risk lowered their ability to borrow. In the current crisis, we also observe an increase in sovereign risk as measured by their CDS spreads (see Figure 4.2), although the increases are typically less than in previous crises.[69] Additionally, Table 4.2 documents correlations between these spreads, on the one hand, and employment and hours per worker, on the other, for emerging economies. It shows that cyclical properties of these margins with spreads instead of with output still suggests strong responses in these margins. Therefore, a model that emphasizes the importance of financial shocks on margins of labour input should be able to explain these movements, as well. We show below that the model can generate comovement of such labour market outcomes, not only with output but also with interest rates.

[69] In the 2008 global financial crisis, what may have also affected emerging economies is the illiquidity in international financial markets, suggesting a decreased capability to borrow at longer horizons. While we do not model features such as borrowing constraints or borrowing at different horizons, these features would just amplify our results by making the *effective* cost of borrowing even more responsive during crisis.

4.3 Model

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

4.3.1 The Firm's Problem

A continuum of a large number of competitive firms produce a single tradable good at a world-determined price, which is normalized to one. Output is produced by a constant returns to scale production function: $y_t = A_t k_t^{\zeta}(n_t l_t)^{1-\zeta}$. For the inputs of production, firms hire labour in the form of the number of workers, n_t, as well as hours per worker, l_t, and rent capital, k_t from households. As opposed to applications of the search framework for emerging economies, we allow the intensive margin of the labour input, l_t, to vary over time and to be chosen as an outcome of Nash-bargaining problem, the details of which will be given in a later section.

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

The individual firm faces a market-driven job filling rate given during the recruiting process. We denote the job filling rate by $\Psi(\theta_t) = \frac{M(v_t,u_t)}{v_t}$, where $\theta_t = \frac{v_t}{u_t}$ is a measure of market tightness, and assume that there is an exogenous separation rate between workers and jobs, ψ. Then, employment

evolves according to the following law of motion: $n_t = (1-\psi)n_{t-1} + \Psi(\theta_t)v_t$. According to this law of motion, a vacancy can become productive at the same period of posting.

Along with the labour market friction, firms are also subject to a working capital requirement. They need to acquire working capital loans to pay a fraction of their wage bill before output is available[70] and in order to do so they borrow from abroad at the beginning of the period. This type of friction is widely used in macroeconomic papers since wage payments are an important item in the firms' operating expenses as opposed to capital payments (business profits) to household.[71] The fraction of the wage bill that has to be paid in advance is denoted by ϕ. Finally, firms use the same stochastic discount factor as households for the present value of future profits, which is $\Pi_{t,t+1} = \beta u_{c,t+1}/u_{c,t}$ where u_c is the marginal utility of consumption, the details of which are given in the next section.

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

$$\begin{aligned} V_t^F(n_{t-1}, \epsilon_t) &= \max_{v_t, k_t} \; y_t - (1 + \phi(R_{t-1} - 1))w_t n_t l_t - r_t k_t - \kappa v_t \\ &\quad + E_t \Pi_{t,t+1} V_{t+1}^F(n_t, \epsilon_{t+1}) \\ s.t. \quad n_t &= (1-\psi)n_{t-1} + \Psi(\theta_t)v_t. \end{aligned} \tag{4.1}$$

where r_t is the rental payment to households and $\epsilon_t = [A_t, R_t]$ is the exogenous state space, namely, the current values of TFP and the interest rate, R_t, on the internationally-traded bond. Following Neumeyer and Perri (2005), firms pay R_{t-1} as interest for working capital loans that are borrowed at the beginning of the period before consumption and investment decisions are made.[72]

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

[71] See Christiano and Eichenbaum (1992) and Neumeyer and Perri (2005) for the macro implications of this type of friction.

[72] Using the current interest rate, R_t, does not change the results since the interest rate

The optimality condition for vacancies is:

$$\frac{\kappa}{\Psi(\theta_t)} = \frac{\partial V_t^F}{\partial n_t}. \tag{4.2}$$

Firms choose the number of vacancies such that the cost of posting an additional vacancy equals to the value of filling an additional vacancy conditional on the vacancy being filled, where the latter phenomenon occurs with a probability of $\Psi(\theta)$.

Based on the envelope condition with respect to n_t, the marginal value of an additional worker can be written as follows:

$$V_n^F \equiv \frac{\partial V_t^F}{\partial n_t} = \frac{\partial y_t}{\partial n_t} - (1 + \phi(R_{t-1} - 1))w_t l_t + (1 - \psi)E_t \Pi_{t,t+1} \frac{\partial V_{t+1}^F}{\partial n_{t+1}}. \tag{4.3}$$

This condition tells us that marginal value of an additional worker is the marginal product of one more worker, $\frac{\partial y_t}{\partial n_t}$, minus the wage cost including the interest payments on working capital plus the asset value of not posting a new vacancy and enjoying the pre-existing relationship with the worker in the next period. We substitute equation (3) into (2) and obtain:

$$\frac{\kappa}{\Psi(\theta_t)} = \frac{\partial y_t}{\partial n_t} - (1 + \phi(R_{t-1} - 1))w_t l_t + (1 - \psi)E_t \Pi_{t,t+1} \frac{\kappa}{\Psi(\theta_{t+1})} \tag{4.4}$$

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

$$r_t = A_t \zeta k_t^{\zeta - 1} (n_t l_t)^{1-\zeta} = \zeta \frac{y_t}{k_t} \tag{4.5}$$

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

4.3.2 The Household's Problem

The economy is populated with identical and infinitely-lived households on the interval $[0, 1]$. Each household is considered as an extended family which

is persistent.

contains a continuum of family members endowed with one unit of time. Each member derives utility from consumption c_t and leisure $1 - l_t$ where the total time that is devoted to labour and leisure is normalized to one. Members in this family either work and supply l_t amount of labour or stay unemployed. Employed members earn w_t per hour which is determined by Nash bargaining along with the amount of working-hours.

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

$$\textit{Separable Preferences (SP)}: \quad u(.) = U(c_t) + n_t\varphi^e H(1 - l_t) + (1 - n_t)\varphi^u H(1)$$

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

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

In addition to the standard separable preferences mostly used in search papers, we wish to evaluate results from Jaimovich-Rebelo (JR) preferences as well. These preferences are non-separable across consumption and leisure: $U(c_t - G(x_t, l_t)) = \frac{(c_t - \varphi^e l_t^\eta x_t)^{1-\sigma} - 1}{1-\sigma}$, $\eta > 1$, $\varphi^e > 0$ if the family member is employed. The second term in the utility function $G(x_t, l_t)$ expresses the disutility of labour which is twice-continuously-differentiable and convex function in hours per worker. In addition, $x_t = c_t^\gamma x_{t-1}^{1-\gamma}$ determines the strength of income effect on labour decisions depending on the parameter γ.

Note that when $\gamma = 0$ these preferences show the same characteristics as in preferences discussed in Greenwood, Hercowitz and Huffman (1988) (GHH henceforth). These types of preferences eliminate income effect on labour supply. They are very common in the literature since they tend to generate a more realistic labour movements in open economies.[73] The issue is more crucial for emerging economies where we observe high volatility in interest rates, having a potential to produce larger wealth effects on labour supply.[74] This is why we analyze the model here under two different preferences. Lastly, the utility function for the unemployed member is assumed to be $U(c_t+\varphi^u) = \frac{(c_t+\varphi^u)^{1-\sigma}-1}{1-\sigma}$, where $\varphi^u > 0$ denotes the minimum consumption level for an unemployed worker.

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

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

$$s.t. \qquad c_t + i_t + b_t + \Phi(b_t) = n_t w_t l_t + r_t^k k_t + R_{t-1} b_{t-1} + \pi_t \tag{4.6}$$

$$i_t = k_{t+1} - (1-\delta)k_t + \Phi(k_{t+1}, k_t) \tag{4.7}$$

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

where $\Omega(\theta_t) \equiv \frac{M(.)}{u_t}$ denotes the probability of finding a job. Quadratic convex cost functions, $\Phi(.)$ and $\Theta(.)$ make bond holdings and adjustments in investment costly. These are standard in SOE-RBC studies to make sure that the model exhibits stationary properties, particularly to solve the

[73] See, for instance, Devereux et al. (1992) and Hairault (2002).

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

unit-root problem for bond holdings and to prevent excessive investment.[75] Lastly, the capital stock depreciates at the rate of δ every period.

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

$$n_t c_t^e + (1 - n_t)c_t^u + i_t + b_t + \Phi(b_t) = n_t w_t l_t + r_t^k k_t + R_{t-1} b_{t-1} + \pi_t \quad (4.8)$$

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

Based on the envelope condition with respect to n_t, we obtain the value of an additional worker to the household, depending on the type of preferences, as:

$$V_n^H \equiv \frac{\partial V_t^H}{\partial n_t} = \begin{cases} (u^e - u^u) + \lambda_t w_t l_t + \beta E_t \frac{\partial V_{t+1}^H}{\partial n_{t+1}}(1-\psi)(1-\Omega(\theta_t)) & (SP) \\ (u^e - u^u) + \lambda_t [w_t l_t - c_t^e + c_t^u] + \beta E_t \frac{\partial V_{t+1}^H}{\partial n_{t+1}}(1-\psi)(1-\Omega(\theta_t)) & (JR) \end{cases} \quad (4.9)$$

where u^e and u^u denotes the utilities for employed and unemployed family members respectively, and λ_t represents marginal utility of consumption of a family member. For both the separable and non-separable cases, the first term illustrates the net utility loss from being unemployed relative to being employed, conditional on the level of the consumption. The second term differs depending on the nature of preferences: in the separable case, the second term shows the marginal value of being employed in terms of the value of wage payments. By contrast, in the non-separable case, the additional term reflects the idea that when a family member becomes employed, s/he is entitled to a different amount of consumption and hence, there is an expenditure difference on consumption (See, for instance, Hall and Milgrom (2008)). Finally, the last term is the discounted expected future marginal value of future employment, where the weighting factor reflects the probability of still being employed in the next period, $1-\psi$, as well as the probability

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

of finding a job when separation occurs, $\psi\Omega(\theta_t)$, plus the opportunity cost of taking up employment, $\Omega(\theta_t)$. In the next section, we derive the solution to the Nash bargaining problem between the household and the firm, which is based on their relative valuations of additional employment shown in equations (4.3) and (4.9).

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

$$1 + \frac{\partial \Phi(b_t)}{\partial b_t} = \beta E_t \left[\tfrac{\lambda_{t+1}}{\lambda_t} R_t \right] \tag{4.10}$$

$$1 + \frac{\partial \Theta(k_t, k_{t+1})}{\partial k_{t+1}} = \beta E_t \left[\tfrac{\lambda_{t+1}}{\lambda_t} (1 + r_{t+1} - \delta - \tfrac{\partial \Theta(k_{t+1}, k_{t+2})}{\partial k_{t+1}}) \right]. \tag{4.11}$$

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

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

$$\lambda_t = c_t^{-\sigma}, \tag{4.12}$$

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

$$\lambda_t = (c_t^e - \varphi^e l_t^\eta x_t)^{-\sigma} + \tau_t \gamma \frac{x_t}{c_t} \tag{4.13}$$

$$\lambda_t = (c_t^u + \varphi^u)^{-\sigma}. \tag{4.14}$$

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

that:

$$(c_t^e - \varphi^e l_t^\eta x_t)^{-\sigma} \varphi^e l_t^\eta + \tau_t = \beta E_t \left[(1-\gamma)\tau_{t+1} \frac{x_{t+1}}{x_t} \right]. \tag{4.15}$$

4.3.3 Nash Bargaining

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

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

where μ is the bargaining power for the worker. The problem above is subject to the value of an additional worker to the firm and household derived earlier as equations (3) and (9), respectively. Here, V_n^H is divided by λ_t in order to express everything in terms of consumption units.

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

$$\frac{V_n^H/\lambda_t}{V_n^F} = \frac{\mu}{1-\mu}. \tag{4.16}$$

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

$$-\frac{u_l}{\lambda_t} = \frac{y_{nh}}{(1+\theta(R_{t-1}-1))} \tag{4.17}$$

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

4.3.4 Equilibrium Prices and Allocation

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

(i) the allocations solve the firm and household problems at the equilibrium prices,
(ii) the Nash Bargaining solutions are satisfied.
(iii) The market for capital clears, i.e, firms' capital demand is equal to the capital supplied from households: $k_t^{demand} = k_t^{supply} = k_t$.
(iv) Goods markets clear:

$$c_t + i_t + nx_t + \kappa v_t + \Phi(b_t) = y_t \tag{4.18}$$

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

4.4 Quantitative Analysis

The model is solved by log-linearizing the equilibrium conditions around the steady state,[76] which is then parameterized so that the deterministic steady state of the model matches several average ratios of macroeconomic aggregates of the Mexican economy. The period in the calibration is 1993Q1-2008Q4 for which we have quarterly data from OECD and Mexican National Statistics, (INEGI). The summary of parameter values from calibration can be seen in Table 4.3.

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

4.4.1 Calibration of Parameter Values

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

For the parameters of preferences, the coefficient of relative risk aversion, σ, is set equal to 2. We then calibrate the parameters for the elasticity of labour supply in separable and JR preferences, ν and η, respectively, so that the model matches a Frisch elasticity of labour supply of 0.5, which is in the range given by Blundell and Macurdy (1999)).[77] This implies parameter values for ν and η equal to 1.77 and 2.66. Hours per worker at the steady state, $\bar{l}$, is set to 0.53 which is the ratio of total hours worked and non-sleeping hours per employee in Mexico. The leisure weight coefficients, φ^e and φ^u, for separable preferences are determined using the optimality condition for hours worked and optimal wage equation at the steady state. These parameters affect the consumption ratios across employed and unemployed agents in JR preferences. The previous literature based on evidence for the US has suggested that the unemployed have a 15% lower consumption than the employed.[78] We set φ^e in JR preferences to 1.29 to match this ratio between the employed and the unemployed. The parameter, φ^u, is then found to be -0.01 using the equality of marginal utility of consumption across the employed and the unemployed. The parameter that governs the strength of

[77] Blundell and Macurdy (1999) estimate the elasticity of labour supply to be in the range of [0.5,1] for the US. We used the low end for Mexico as incomes are much lower than in the US.

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

the income effect, γ, is assumed to be 0.5, which is the mid-point of feasible values.

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

The working capital parameter, ϕ is assumed to be 1 as in Neumeyer and Perri (2005), which implies that workers have to be paid three months before the sales are cashed out.[79] The net foreign asset ratio held by households at the steady state, $\frac{\bar{b}}{\bar{y}}$, is calculated using the debt ratios from Lane and Milesi-Ferretti (2007) that are estimated from the external wealth of countries. The ratio of net foreign assets to GDP for Mexico in this dataset is equal to -0.40. Note that, in our model, net foreign assets is the household's foreign bond holdings net of working capital loans of the country: $b_t - \phi w_t l_t$. Accordingly, the ratio $\frac{\bar{b}}{\bar{y}}$ is calculated as 0.17. The ratio of economic profit and output is found to be 0.0028 in the model, which is different than zero due to the

[79] As we discussed in Chapter 3, working capital requirement might be less important for some sectors of the economy, such as the self-employed. That is why we set a value less than one in that chapter. However, note that the model in 3 had other financial friction, such as a collateral constraint; it is shown that the introduction of this constraint has implications similar to those of a higher working capital requirement. Therefore, given that we do not have any type of collateral constraints here, we believe that the assumed value for ϕ could be reasonable.

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

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

Shock Processes. The recent literature has shown the importance of shocks to interest rate in the fluctuations in emerging markets.[80] Emerging markets differ from developed markets in terms of the behaviour of the interest rate they face. Interest rates are countercyclical mainly because of default risk that is negatively correlated with the output. Following this literature, we assume that shocks to productivity (in logs) and interest rates (log of *gross* interest rate) are correlated simultaneously such that $\epsilon_t = [\epsilon_t^A, \epsilon_t^R]$ is drawn from an i.i.d normal bivariate distribution, $N(0, \Sigma)$, with zero mean and covariance, Σ. Each shock follows an independent AR(1) process:

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

with

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

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

We construct Solow residuals for the TFP shocks over the sample period in Mexico using the seasonally adjusted real GDP, total hours worked and capital stock series. We have data on real GDP from the OECD, and total hours worked and employment in manufacturing from INEGI. In order to calculate hours worked in the overall economy, we first divide hours worked in manufacturing by the employment in manufacturing and then multiply it by total employment each quarter in Mexico. We take historical employment series from Neumeyer and Perri (2005) and extend it to 2008Q4 using the the growth of employment series from ILO.

The capital stock series is constructed using seasonally-adjusted quarterly investment series from the OECD and the depreciation rate.[81] Using series on the capital stock and the labour input, we now calculate the Solow residuals as $lnA_t = lnY_t - \zeta lnK_t - (1-\zeta)lnL_t$. The HP-filtered series yields the persistence as $\rho_A = 0.80$ and the standard deviation as $\sigma_A = 1.1\%$. The persistence is quite lower than the counterparts for developed countries. This raises a question about measurement problems in constructing these series. That is why we will also consider different shock processes in the sensitivity analysis in order to check if the results are robust to more persistent shocks.

For the interest rates, we have two different representative costs of borrowing: EMBI+ dataset from Uribe and Yeu (2006) and real domestic interest rates on Mexican T-bills from IFS. EMBI+ dataset documents spreads for traded debt instruments for various countries including Mexico. In Chapter 3, we show that the interest rates constructed using these spreads show a significantly smaller volatility than that of domestic rates. In fact, the standard deviation of Mexican rates from EMBI is around 0.55% at quarterly levels whereas the domestic rates are almost four times more volatile, 2%.[82] Although EMBI+ rates have been widely used in the literature as the

[81] Initial capital-output ratio is assumed to be equal to 10 so that the average ratio over sample period corresponds to 7.6 as in the model. Note that Mexico experienced an economic boom in the initial year, 1993 – the year before the 1994 crisis.

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

representative cost of borrowing, this discrepancy between two rates raises questions on the other potential costs of external borrowing which EMBI+ ignores.[83] That is why we take the volatility of EMBI+ rates as the lower bound of the volatility of the cost of borrowing and that of domestic rates as the upper bound. When we assume that shocks to interest rates have the same volatility as the productivity shocks, $\sigma_A = \sigma_R = 1.1\%$, the interest rates in the model represent a volatility very close to the average of standard deviations of the two interest rate series.

For the persistence of the shock to interest rate, ρ_R, domestic and EMBI-constructed rates show autocorrelation coefficients of 0.59 and 0.68, respectively. In our calibration, we set this parameter equal to 0.64, the average of those autocorrelation coefficients. We set the correlation parameter between shocks to productivity and interest rates, $\rho_{\epsilon_A,\epsilon_R}$, to the average correlation between interest rate and TFP from two series of interest rates, -0.58. With EMBI+ rates this correlation is -0.56 and with domestic rates, the correlation is -0.61.

4.4.2 Characterization of Equilibrium and Impulse Responses

Without Working Capital. We now discuss the role of search and financial frictions and how endogenous decisions at the intensive margin affect the amplification that such frictions generate. We start by discussing the case with only search frictions to show their sole effects on the fluctuations as a response to shocks to productivity and interest rates. The key equation in the models with search frictions is the wage equation. Regardless of the separability in preferences, we can write down the optimal wage equation by

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

Table 4.3: Parameter Values

Parameter	Value	Source	Parameter	Value	Source
I. Preferences			*III. Production*		
Discount factor, β	0.98	calibrated	Capital exponent, ζ	0.36	literature
Relative risk aversion, σ	2	literature	Working capital, ϕ	1	assumed
Separable Pref.					
Labour curvature, ν	1.77	calibrated	*IV. Shocks*		
Coef. of leisure (emp.), φ^e	0.36	calibrated	Persistence, ρ_A	0.80	estimated
Coef. of leisure (unemp.), φ^u	-1.36	calibrated	Persistence , ρ_R	0.64	estimated
JR Pref.			Correlation coef., $\rho_{\epsilon_A,\epsilon_R}$	-0.58	estimated
Labour curvature, η	2.6	calibrated	Std. deviation, σ_{ϵ_A}	0.011	estimated
Coef. of leisure (emp.), φ^e	1.29	calibrated	Std. deviation, σ_{ϵ_R}	0.011	estimated
Coef. of leisure (unemp.), φ^u	-0.01	calibrated			
Income effect, γ	0.50	assumed			
II. Search			*V. Other*		
Elas. of job matches, α	0.5	literature	Bond holding cost, φ^b	0.01	literature
Matching efficiency, ω	0.66	calibrated	Capital adj. cost, φ^k	25	literature
Cost of posting vacancy, κ	0.75	calibrated	Depreciation rate, δ	0.025	literature
Job separation rate, ψ	0.06	BM (2008)	SS bond holdings, $\frac{\bar{b}}{\bar{y}}$	-0.40	data
Bargaining power, μ	0.5	assumed			

combining the share rule in equation (16) with equations (2), (3) and (9):

$$w_t l_t = \frac{1}{1+\mu\phi(R_{t-1}-1)}\left\{\mu(y_n + \kappa E_t \Pi_{t,t+1}\theta_{t+1}) + (1-\mu)\frac{u^u - u^e}{u_c}\right\}, \tag{4.19}$$

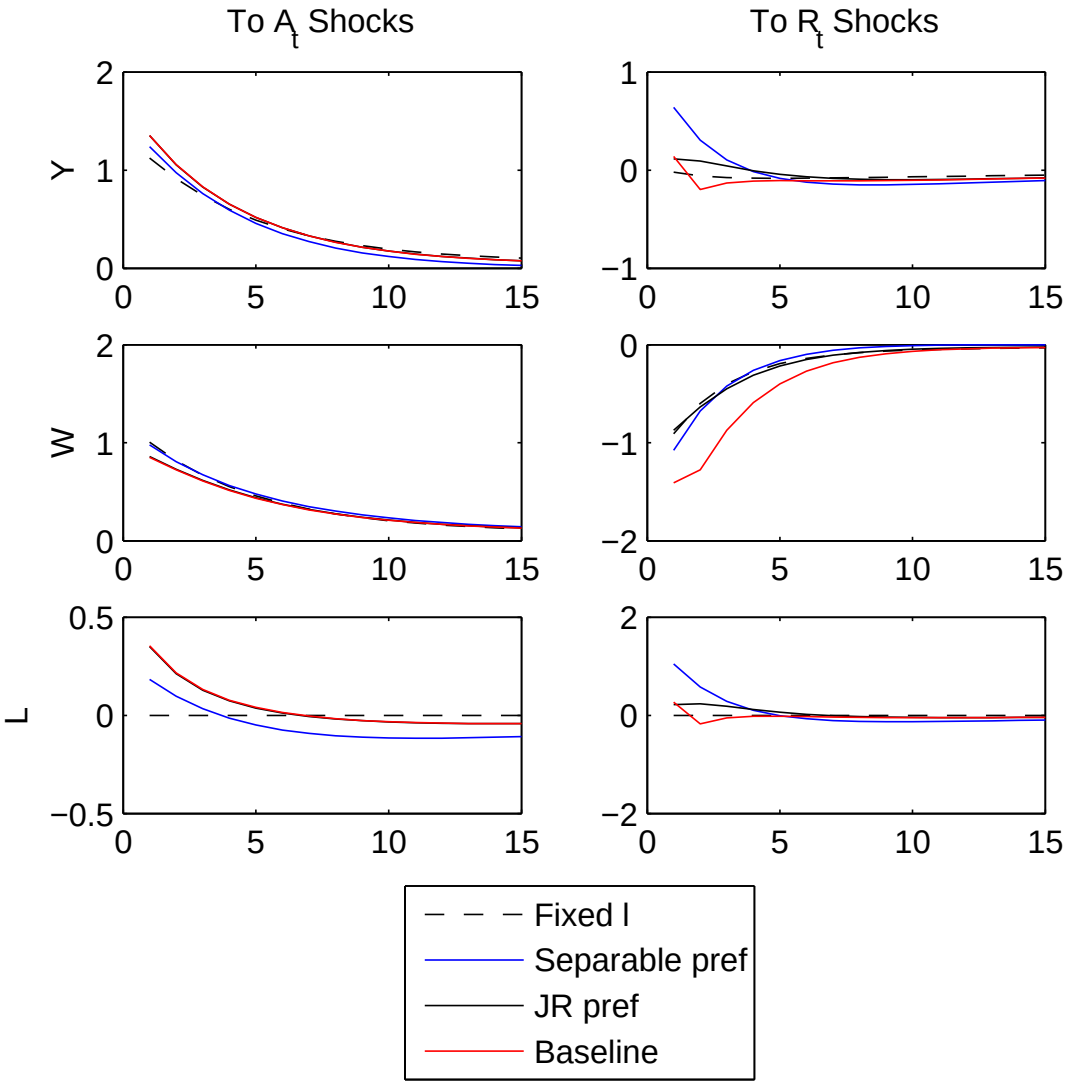
where we have substituted for λ_t in equation (8) using the marginal utility of consumption as u_c.

The above condition tells us that labour income of the employed (wage bill per job) is a combination of the worker's contribution to output at the margin – which is the marginal productivity and the average savings in vacancy costs – and the worker's outside option, which is the utility of foregone leisure evaluated in terms of the marginal utility of consumption, depending on the bargaining power of the household. The second term which makes the wage equation different from that in the standard RBC model becomes much more important in a model with interest rate shocks. As a response to a negative productivity shock, for example, interest rates tend to increase, which causes a larger drop in consumption than in the case with just productivity shocks[84]. As a result, the wage bill falls not only because marginal productivity decreases but also because the worker's outside option drops due to a higher marginal utility of consumption. In other words, the expected value of staying unemployed and searching for a job in the next period becomes smaller.

However, note that the amplification of this mechanism on wages depends on the changes in the hours per worker, l_t. Movements in the hours per worker will affect the fluctuations in wages through not only their effect on the wage bill on marginal consumption. In order to illustrate this point, we now explore the optimal decision for the intensive margin. The log-linearized version of equation (16) for each form of utility can be expressed

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

Figure 4.3: Impulse Responses



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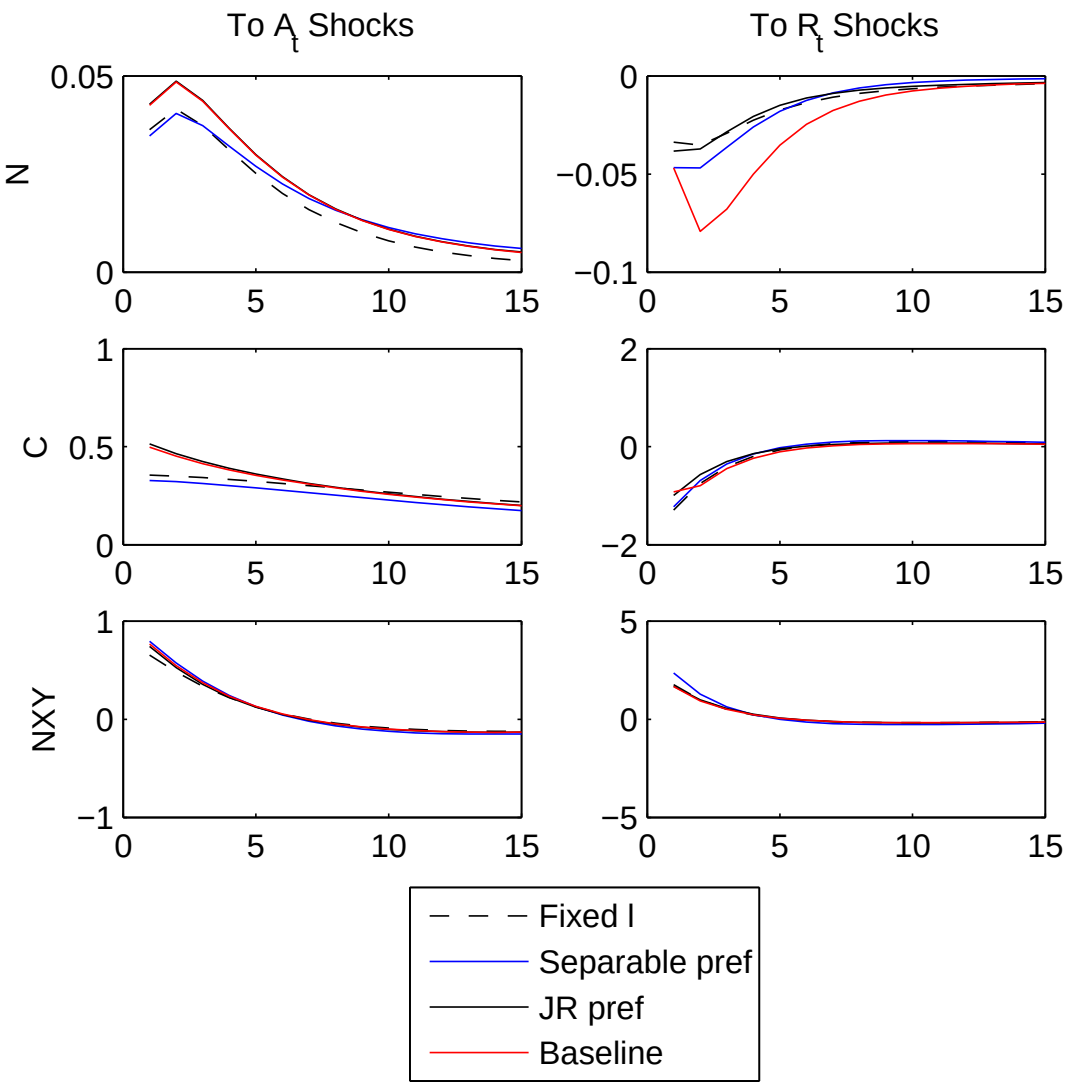
To A_t Shocks
To R_t Shocks
N
C
NXY
0.05
0
−0.05
−0.1
1
0.5
2
−2
−1
5
−5
0
5
10
15
Fixed l
Separable pref
JR pref
Baseline

as below:

$$\widehat{l}_t = \frac{\widehat{A}_t + \zeta\widehat{k}_t - \zeta n_t - \sigma\widehat{c}_t}{\frac{\nu\bar{l}}{1-\bar{l}} + \zeta} \qquad \text{(separable preferences)} \tag{4.20}$$

$$\widehat{l}_t = \frac{\widehat{A}_t + \zeta\widehat{k}_t - \zeta n_t - \widehat{x}_t}{\eta - 1 + \zeta} \qquad \text{(JR preferences)} \tag{4.21}$$

The difference in these equations comes from the strength of the income effect they have on the labour supply decisions. This effect is captured by $\sigma\widehat{c}_t$ in separable preferences and is stronger than in JR preferences where $\widehat{x}_t = \gamma\widehat{c}_t + (1-\gamma)\widehat{x}_{t-1}$. We can see how this income effect changes hours decisions across different preferences in Figure 4.3, which plots impulse responses of selected variables to one standard error shock in TFP and interest rates. These impulse responses show us that hours per worker increases as a response to a shock to interest rates in the model with separable preferences (Figure 4.3, blue line). This also generates an increase in output when the interest rate goes up. This result is inconsistent with the data where both output and hours per worker tend to be decreasing during the periods with higher interest rates in emerging markets as discussed in section 2.

Note that this counterfactual result makes wages more responsive to interest rates. In order for the wage bill to fall, the wage has to decrease sharply as a response to interest-rate shocks. The wage response is still high when we take the intensive margin as fixed (Figure 4.3, dotted line). Thus, the wage responds more in these cases at the expense of movements in the intensive margin. On the other hand, when we take JR preferences (Figure 4.3, black line), which have a smaller income effect on the intensive margin, responses of hours per worker improve both to productivity and interest rate shocks. This improvement in hours come with a cost: the wage response becomes smaller to productivity shocks. Therefore, intensive margin plays an important role in the contribution of search frictions on wage fluctuations.

With Working Capital. Although JR preferences reduce the income effect on labour supply, the impulse responses still show a slight increase in

hours per worker as a response to a positive shock in interest rates. One can further decrease the strength of the income effect, however; as we will show in the sensitivity analyses, this will result in a large drop in the response of wages. Instead, here we show that the presence of a financial friction, namely working capital, dominates the income effect on labour supply and predicts the right movements for hours per worker. In the presence of a working capital requirement, equation (20) can be rewritten as:

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

Since $\phi > 0$, the above equation implies that a positive shock to interest rates will have a negative effect on hours per worker. This suggests that demand for labour in the model economy as a response to a positive interest rate shock is lower in the case with working capital than before. In fact, impulse responses in the presence of working capital, which will be denoted as "the baseline model" henceforth, show that hours per worker tends to decrease as a response to an interest rate shock in the second period (Figure 4.3, red line). This generates an output drop after an increase in the interest rate consistent with the data. The model with working capital also increases the responsiveness of wages to interest rates significantly. This result can be seen through the wage equation in the model with working capital. If we denote $w_t^1 l_t^1$ as the wage bill in equation (18), the wage bill in the presence of working capital, $w_t^2 l_t^2$ will be:

$$w_t^2 l_t^2 = \frac{w_t^1 l_t^1}{1 + \mu\phi(R_{t-1} - 1)}$$

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

For the other impulse responses, it is worth to remark the responses of employment and goods market variables, such as consumption and net

exports, as well. The baseline scenario produces the most amplified response of employment among others due to the effect of cost of borrowing on labour demand, and consequently on vacancy decisions. On the other hand, the preferences and frictions discussed here play a smaller role on goods market (consumption and net exports) than labour market variables, except that consumption responses less to a TFP shock under separable preferences and fixed intensive margin because less responsive employment and hours per worker generate a smaller output.

4.4.3 Quantitative Results

We summarize the results from simulations of various versions of the model in Tables 2 and 3. We first simulate the model with only search frictions with a fixed intensive margin as in Boz *et al* (2009). We, then, continue with results from endogenizing intensive margin for both types of preferences. In doing this, our aim is to analyze how much search frictions contribute to fluctuations in emerging markets discussed in earlier sections, particularly the positive correlation between intensive margin and extensive margin of labour, highly volatile real wages and labour share, procyclical wages, labour input and labour share, highly volatile consumption and countercyclical net exports. We, lastly, simulate the model with working capital to investigate the effect of a financial friction on these fluctuations over search frictions.

Fixed and Endogenous Intensive Margin. The first column in Table 4.4 shows the business cycle moments in data for Mexico. The second and third columns, then, report the implications of the standard frictionless SOE-RBC model and the search model with a fixed intensive margin and separable preferences. When hours per worker is taken constant as in Boz *et al* (2009), search model can explain some distinguishable characteristics of the fluctuations in emerging markets such as countercyclical interest rates, very procyclical and highly volatile consumption and countercyclical net exports. However, SOE-RBC alone, with fixed labour input does a similar job in terms of these fluctuations. The contribution of search frictions on

these fluctuations is then minimal.

Table 4.4 shows that the search model has a stronger effect on the response of labour market variables compared to the standard SOE-RBC. These findings are similar with those of Andalfotto (1996) and Merz (1995), finding significant contribution of search frictions to the fluctuations in the labour market rather than goods market. For instance, the third column shows a significant increase in wage volatility compared to the one in SOE-RBC. However, as we have shown above, wages here are the only variable to respond in the wage bill per job since the intensive margin is fixed. Nevertheless, the search model gives a momentum to the labour share whereas this is constant in the frictionless SOE-RBC model.

Although search frictions seem to amplify the responses of labour market variables, particularly wages and labour share under separable utility, the results change considerably when we let the intensive margin respond endogenously. The last column shows that the model implies a large income effect and consequently a very strong positive correlation between interest rates and hours per worker, which is the opposite of what we observe in data. This makes interest rates no longer countercyclical even though productivity and interest rate shocks are negatively correlated because an increase in hours per worker as a response to an increase in interest rates tends to have a positive impact on output. As a result, a large number of cyclical properties of the search model fail to predict the ones in the data. Since total hours tend to be weakly correlated with output, labour share becomes acyclical in this model whereas it is significantly procyclical in the data. In addition, wages become less cyclical and slightly more volatile at the expense of counterfactual movements in the intensive margin. These failures with separable preferences shows that it is important to understand the intensive margin decisions in order to assess the contribution of search frictions to the fluctuations in emerging economies.

Baseline Model. The results with JR preferences can be seen in Table 4.5. Our baseline model (the second column) that has JR preferences and working capital improves the implications of the model significantly. With a reduced income effect due to JR preferences and a more effective labour

Table 4.4: Results with Separable Preferences

	Data	RBC Fixed l	Search Fixed l	Search Endo. l
Standard Deviation				
Output	2.39	1.34	1.36	1.31
Net Exports	1.10	1.65	1.67	2.24
Labour Share	3.56	0.0	1.11	0.76
Standard Deviation (Relative)				
Wage	1.79	1.00	1.57	1.58
Hours per worker	0.24	0.0	0.0	0.81
Employment	0.43	0.0	0.07	0.08
Total hours	0.61	0.0	0.07	0.76
Consumption	1.03	1.25	1.23	1.21
Correlation with Y				
Int. Rate	**-0.54**	-0.56	-0.56	**-0.10**
Wage	0.40	1.0	0.91	0.55
Hours per worker	0.58	0.0	0.0	0.13
Employment	0.57	0.0	0.63	0.57
Total hours	0.68	0.0	0.63	0.20
Labour Share	**0.47**	0.0	0.55	**0.04**
Consumption	**0.92**	0.69	0.70	**0.26**
Net Exports	**-0.81**	-0.12	-0.13	**0.33**
Correlation with R				
Hours per worker ,l	**-0.28**	0.0	0.0	**0.96**
Employment, n	**-0.48**	0.0	-0.88	**-0.83**
Corr(n, l)	**0.48**	0.0	0.0	**-0.68**

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

demand due to working capital, the model can mimic the cyclical properties of the variables that are related to the labour market. As well, the model does a better job on the cyclical properties of consumption and net exports relative to the alternatives.

In the baseline model, the comovement between hours per worker and interest rates has the right sign. Consequently, interest rates are countercyclical with output. In addition, since both margins of the work similarly responds to both shocks in the model, hours per worker and employment are positively correlated with each other, as in the data that we displayed in Table 4.1. This is in contrast to the implications from the model with separable preferences discussed earlier. For more comparisons, we include the results from the frictionless SOE-RBC model (third column) and the results from the model with only search frictions; i.e.; without working capital (fourth column). The baseline model performs better in terms of generating countercyclical interest rates. In addition, without working capital, the model cannot explain the strong comovement between hours per worker and the number of people employed, mainly because it fails to explain the response of the hours per worker to interest rates even under JR preference that implies a smaller income effect. Thus, although a smaller income effect can partially improve the correlation between the margins of the work; without the financial requirement – working capital – it is not enough to explain the comovement we observe in the data.[85]

The high volatility of wages in emerging markets is noted in Chapter 2 of this dissertation. The baseline model here can explain such highly volatile wages thanks to the presence of both search and financial frictions. In terms of the comovement with output, the model overpredicts the procyclicality of wages with output. However, we should mention that they become more procyclical with current output in the data when the leads of wages are considered. For instance, the correlation between current output and wages

[85]The reader might question the contribution of working capital as opposed to just lowering the strength of income effect further. Hence, to address this question, a discussion on the sensitivity of the parameter that governs the strength of income effect,γ, will follow this section.

Table 4.5: Results with JR Preferences

	Data	Baseline Model	RBC	Search Only $\theta = 0$	Uncorrelated Shocks $\rho_{\epsilon_A,\epsilon_R} = 0$
Standard Deviation					
Output	2.39	1.64	1.58	1.52	1.63
Net Exports	1.10	1.55	1.56	1.55	2.10
Labour Share	3.56	**1.73**	0.0	**0.84**	1.80
Standard Deviation (Relative)					
Wage	**1.79**	**1.54**	**0.78**	**1.19**	1.27
Hours per worker	0.24	0.27	0.40	0.24	0.32
Employment	0.43	0.10	0.0	0.07	0.07
Total hours	0.61	0.34	0.40	0.26	0.36
Consumption	1.03	0.96	0.89	0.98	0.82
Correlation with Y					
Int. Rate	-0.54	-0.52	-0.41	-0.47	0.03
Wage	0.40	0.81	0.93	0.84	0.50
Hours per worker	0.58	0.81	0.69	0.58	0.83
Employment	0.57	0.83	0.0	0.84	0.58
Total hours	0.68	0.88	0.69	0.77	0.86
Labour Share	0.47	0.52	0.0	0.37	-0.05
Consumption	0.92	0.77	0.74	0.73	0.42
Net Exports	-0.81	0.01	0.15	0.03	0.48
Correlation with R					
Hours per worker, l	**-0.28**	**-0.21**	**0.20**	**0.26**	0.27
Employment, n	**-0.48**	**-0.76**	0.0	-0.78	-0.66
Corr(n, l)	**0.48**	**0.64**	0.0	**0.07**	0.40

JR preferences are used in all models here. The baseline model has both search frictions and working capital with the calibrated parameters described in the text. "Search Only" stands for the baseline model without working capital ($\theta = 0$). The last column lists the results from the baseline model with zero correlation between productivity and interest rate shocks.

Table 4.6: More Sensitivity Analyses

	Data	Baseline Model	Full Income Effect $\gamma = 1$	Zero Income Effect $\gamma = 0$	More Volatile Shocks
Standard Deviation					
Output	2.39	1.64	1.56	2.03	2.39
Net Exports	1.10	1.55	1.77	1.41	2.28
Labour Share	3.56	**1.73**	1.71	1.73	2.40
Standard Deviation (Relative)					
Wage	**1.79**	**1.54**	**1.65**	**1.13**	**1.67**
Hours per worker	0.24	0.27	0.29	0.52	0.26
Employment	0.43	0.10	0.10	0.08	0.10
Total hours	0.61	0.34	0.35	0.60	0.29
Consumption	1.03	0.96	1.07	0.96	1.12
Correlation with Y					
Int. Rate	-0.54	-0.52	-0.47	-0.60	-0.54
Wage	0.40	0.81	0.79	0.86	0.87
Hours per worker	0.58	0.81	0.57	0.94	0.81
Employment	0.57	0.83	0.0	0.89	0.82
Total hours	0.68	0.88	0.71	0.94	0.84
Labour Share	0.47	0.52	0.50	0.62	0.60
Consumption	0.92	0.77	0.69	0.89	0.87
Net Exports	-0.81	0.01	0.03	-0.07	-0.18
Correlation with R					
Hours per worker, l	**-0.28**	**-0.21**	**0.23**	-0.62	-0.35
Employment, n	**-0.48**	**-0.76**	-0.77	-0.76	-0.88
Corr(n, l)	**0.48**	**0.64**	0.41	0.95	0.71

JR preferences are used in all models here. The baseline model has both search frictions and working capital with the calibrated parameters described in the text. The third and fourth column show the results from different values for the parameter, γ, that governs the strength of income effect. "Search Only" stands for the baseline model without working capital ($\theta = 0$), and the last column presents the implications from the baseline model with alternative shock process described in the text.

after two quarters is 0.56 compared to 0.40, contemporaneous correlation. We leave this lagging property of wages for future research and focus on the volatility in wages in this work since they present a strikingly higher volatility in emerging markets than in developed markets.

The baseline model can also address a large fraction of the volatility in consumption relative to output volatility. Consumption is more volatile than output and very procyclical in emerging markets, which tend to generate countercyclical net exports in these economies. The model predicts a more volatile and a more procyclical consumption than the frictionless model, consistent with data. As a result, the cyclical properties of net exports are closer to data than the frictionless model predicts, albeit still acyclical. Compared to alternatives, the cyclical properties of these series improve in the baseline model. We show in 3 that borrowing constraints can help to explain the strong countercyclicality of net exports along with the strong procyclicality of consumption with output.

Since the model can explain highly volatile wages and produces the right sign of comovement of labour market variables with output, the labour share becomes more volatile than in the "search only" model, closer to the data. The model can address more than half of the variation in the labour share and procyclicality with output for this variable. The part that is not explained in this model is related to employment fluctuations. The model can only explain about one-fourth of the employment fluctuations due to search frictions. Boz *et al* (2009) introduce shocks to matching efficiency, ω, which increases the volatility for this variable.[86]

One failure of the model is the underestimation of output volatility. As we discussed earlier, this could stem from the measurement problems in producing shocks using data. In the sensitivity analysis, we will use higher volatility for the shocks assuming that output can be explained fully by these shocks and analyze the results compared to baseline model.

The differences in the results between the third and fourth column gives us a better understanding of the sole contribution of search frictions to

[86] In addition, credit imperfections similar to those in Chapter 3 tend to generate more variability in employment (see Petrosky-Nadeau (2011).

fluctuations in emerging markets. As in the case with the fixed intensive margin, the main contribution of search frictions is its impact on variables related to labour markets as opposed to a frictionless model. Search frictions can produce movements in employment and the labour share. In addition, wages become more volatile than in the frictionless model. However, without working capital, the model underestimates the volatility in wages, labour share and output, the negative correlation between interest rate and hours per worker, and the positive correlation between intensive and extensive margins of labour input.

Lastly, we discuss the results when we assume a zero correlation between interest rates and TFP shocks, a situation closer to that in developed markets.[87] The last column in Table 4.5 show that uncorrelated shocks imply a %40 smaller correlation between intensive and extensive margins of the work than does the baseline scenario. This result is consistent with our findings on different fluctuations of hours per worker across country groups in the data.

4.4.4 Sensitivity Analysis

The Strength of the Income Effect: The results in Table 4.5 suggest that with a smaller income effect, the models tend to explain the data moments better compared to results with separable preferences. With JR preferences, this income effect is governed by the parameter, γ, which is set to be equal to 0.50 in the baseline scenario. Now we discuss the sensitivity of the results to this parameter.

Table 4.6 presents the results from sensitivity analyses. The first two columns show the data moments and the results from the baseline model. The third and fourth columns display the implications of the model with full income effect ($\gamma = 1$) and zero income effect ($\gamma = 0$), respectively.[88] Although higher income effect produces cyclical properties closer to data

[87] Note that we are changing only the value of the correlation coefficient; we are not calibrating the whole model to developed markets. Thus, by doing this, our objective is not to explain labour market fluctuations in developed markets. Rather, we aim to discuss the direction of the results with no correlation between shocks.

[88] When $\gamma = 1$, preferences converge to those in King et al. (1988).

for the labour input, it fails to explain the response of hours per worker to interest rates. As a result, the comovement between margins of work is smaller than in the data. In addition, the model with higher income effect generates less cyclical interest rates and consumption than we observe in the data.

On the other hand, a model with zero income effect; i.e., GHH preferences, makes hours per worker more cyclical over the cycle compared to baseline model. Hours per worker are, now, highly correlated with output, employment, and interest rates, which is not consistent with the data. High volatility and cyclicality of labour input comes at the expense of smaller fluctuations in wages. In contrast, the baseline model produces less cyclical hours and wages and more volatile wages, closer to the data.

Robustness to Shocks: In this section, we analyze how robust the results are to different shock processes. We calibrate shock parameters so that they match particular data moments in Mexico as an alternative to estimates used in the previous models. We do this alternative calibration since there are some potential measurement problems in constructing Solow residuals. Specifically, TFP estimates from the data face measurement problems affecting factor shares, utilization rates on factors, and adjustment costs on capital.

The calibration technique used to find alternative parameters are as follows. We assume that the persistence of productivity shocks, ρ_A, is the same as in the US and set this parameter to 0.95, which implies a persistence of output not higher than in the data.[89] The standard deviation of the shock to productivity is set to match the output volatility in Mexico.[90] Therefore, $\sigma_{\epsilon_A} = \sigma_{\epsilon_R} = 1.52$. Lastly, the correlation between shocks is calibrated to match the correlation between output and interest rates, which results in

[89] In the data, the autocorrelation of output is 0.84 and the model presented here with the assumed persistence of productivity predicts this number to be 0.76, which is better than the prediction with the estimated persistence, 0.67.

[90] This type of identification analysis for productivity parameters has been often used in RBC analysis. See, for example, Greenwood *et al* (1988), Mendoza (1991) and Neumeyer and Perri (2005).

$\rho_{\epsilon_A,\epsilon_R} = -0.72$.

The last column in Table 4.6 shows the implications of the baseline model with these alternative parameters in the shock processes. The results change only insignificantly for variables related to the labour market, which implies the findings analyzed above do not depend on the shock process we estimated in the quantitative analyses. The more significant effect of these shocks appears on the fluctuations of goods market variables such that, with more persistent TFP shocks and more volatile shocks, the model produces more volatile and cyclical consumption and net exports, consistent with data.

4.5 Conclusion

The implications of small open economy real business cycle models for explaining emerging market business cycles have been studied extensively in recent years. Many of these studies have concentrated on the implications of such models for generating the observed responses of key macroeconomic variables. Yet increasingly researchers and policy-makers are interested in understanding the cyclical response of labour market variables in emerging economies. During the recent global financial crisis, it is well known that emerging market economies have seen increases in their unemployment rates despite the absence of a negative domestic shock. We here document that hours per employee dropped, too, during the crisis. We also show that this comovement between hours per worker and employment has actually been a characteristics over the cycle in emerging economies, in contrast to advance economies.

In our framework, changes in the cost of borrowing coupled with a friction such as a working capital requirement can lead to changes to both employment and hours of work in a search-theoretic framework. Hence, our framework has the potential to account for the observed changes in emerging economies during the recent global financial crisis when the economy faces an external shock, as much as accounting for emerging economy business cycles more generally.

Chapter 5

Conclusion

Labour market fluctuations in EMs are characterized by highly volatile real wages. I provide four additional facts on these fluctuations and compare them with those in DMs: (1) Labour share is more volatile in EMs. (2) Labour share is also more procyclical in these economies. (3) Volatility of hours per worker relative to the number of people employed is higher in EMs. (4) Hours per worker is procyclical with output and positively correlated with employment in EMs, while they are less cyclical with output and not correlated with employment in DMs.

The findings in Chapter 2 suggest that labour share drops in recessions that are associated by an increase in interest rates, such as debt crises. Labour share then recovers after the crisis, implying a procyclicality with output. Since interest rates are countercyclical in most of the EMs, we tend to observe a procyclical labour share, on average, in these economies. Chapter 3 shows that working capital mechanisms together with countercyclical cost of borrowing can explain some of the volatility in the labour share. When borrowing limits are introduced, the model implications on labour share are amplified. A varying borrowing criterion also accounts for some of the business cycle puzzles in emerging markets, such as highly volatile consumption, strongly procyclical investment and consumption, and countercyclical net exports.

Chapter 4 attempts to answer two more questions: (1) How do we reconcile the stylized facts of the cyclical properties of hours per worker in EMs, and specifically why is hours per worker more correlated with output and employment in EMs than in DMs? (2) How much do search frictions contribute to wage volatility under endogenous hours choice? This chapter shows that a model which incorporates working capital requirement and

search-and-matching frictions together with countercyclical interest rates can account for those observations on the movements in the intensive margin of labour input. Previous work provide explanations on high volatility in real wages using search frictions. However, it is shown in this chapter that these frictions account for a smaller part of the volatility in wages in the presence of endogenous hours choice. Financial frictions still contribute significantly to explain movements in real wages and labour share.

This dissertation also offers some possible avenues for future research. First of all, I do not explore any policy decisions here. Policy makers would take into account the effects of their actions on real interest rates as they might lead to changes in labour share, i.e., large responses of labour markets to economic shocks. Fiscal policy, for instance, might choose to be more cautious than in standard models to achieve stability in real interest rates. In addition, monetary policy have potential to alter aggregate demand not only through traditional Keynesian channels but also through lowering/increasing the income share of labour, which presumably have higher propensity to consume in an economy. Understanding labour share dynamics are also crucial for the estimation of New Keynesian Philips Curve. Finally, it also remains a future work to explore the effects of working capital requirement across firms' external and internal financing under the presence of financial frictions and its implications on goods and labour market fluctuations.

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Appendix A

Appendices to Chapter 2

A.1 Data

Compensation of Employees: We obtain labor cost data mainly from UN. They are compatible with 1993 System of National Accounts. For a detailed source description for each country, see A.1

Interest Rates: The cost of borrowing is obtained mostly from IFS. They are either lending rates, or average cost of borrowing, or T-bill rates depending on data availability for different countries. See A.1 for country specific interest rate definition and the source.

GDP deflator: The data are of the same source as the interest rates for each country.

EMBI rates: The data on EMBI spreads for emerging economies come from Uribe and Yue (2006) dataset. For the recent global financial crisis, we have the data from JP-Morgan EMBI database.

Self-employment ratios: The sources are the OECD for Mexico, Korea, and Turkey; and ILO for the rest of the countries.

Wages: For countries such as Argentina, Mexico, and Turkey, we have wage data for only manufacturing. Wages are total gross earnings per worker except for Argentina, Chile, and Turkey in which they are hourly earnings. The source for wages is ECLAC (Economic Commission for Latin America and the Caribbean) for Brazil, Chile, Costa Rica, and Mexico; ILO for

Philippines; INEC and TURKSTAT (National sources) for Argentina and Turkey, respectively.

Employment: The source is ILO for Chile, Costa Rica, Peru and Philippines. OECD is the source for Korea, Mexico, and Turkey. For Brazil, we obtain the data from IPEA (national source). For Argentina, employment data comes from the World Bank Development Indicators and the time series of employees from ILO.

Sectoral value added: The data on the contribution of the major sectors (agriculture, industry, and services) are from the World Development Indicators (World Bank).

Quarterly data: The data sources are IPEADATA (national source) for Brazil, the OECD for Korea and Mexico, and TURKSTAT (national source) for Turkey for labor share and output. See the above table for the source of the interest rates.

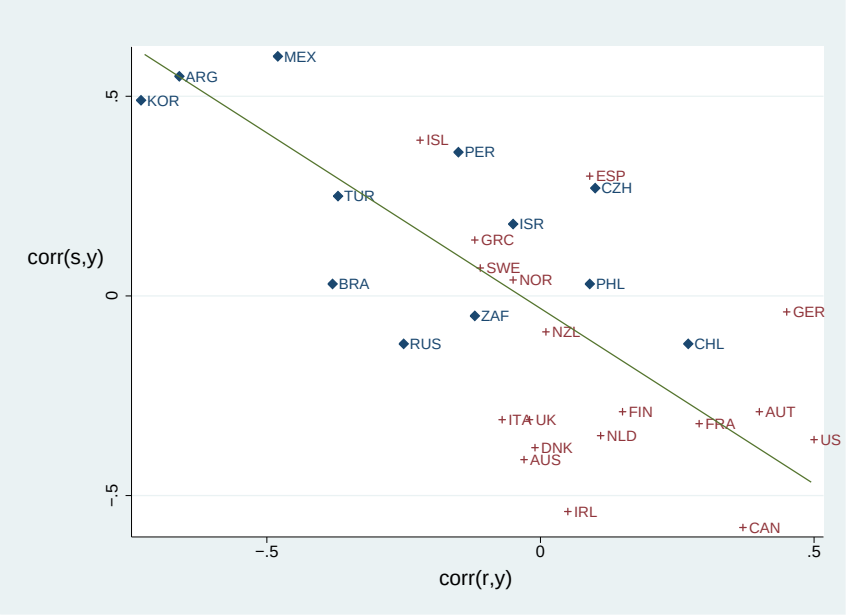
Informal employment: Informal employment refers to the self-employed in their own informal sector enterprises, contributing family workers (unpaid), members of informal producers cooperatives (not established as legal entities), employees holding informal jobs (i.e., jobs not subject to national labor legislation, income taxation, social protection or entitlement to certain employment benefits, such as sick leave); own-account workers engaged in production of goods exclusively for own final use by their household. Therefore, informal employment covers the employment in the informal sector as well as the informal employment in the formal sector (informal jobs in the formal enterprises). The source ILO KILM 8 Indicators.

Table A.1: Data Sources for Labor Compensation and Interest Rates

	Period	Compensation & GDP (VA)	Interest Rates
Emerging Markets			
Argentina	1993-2007	UN	lending rate (IFS)
Brazil	1992-2007	UN	T-bill rate (IFS)
Chile	1981-2007	UN	lending rate (IFS)
Columbia	1992-2007	UN	lending rate (IFS)
Costa Rica	1982-2007	UN	lending rate (IFS)
Czech Rep.	1992-2008	OECD	lending rate (IFS)
Egypt	1996-2006	UN	lending rate (IFS)
Hungary	1995-2008	OECD	lending rate (IFS)
India	1981-2002	UN	lending rate (IFS)
Israel	1995-2007	UN	lending rate (IFS)
Korea	1981-2008	OECD	corporate bond rate (IFS)
Mexico	1981-2008	OECD	ave cost of borr. (IFS)
Peru	1986-2006	UN	lending rate (IFS)
Philippines	1992-2007	UN	T-bill rate (IFS)
Poland	1991-2008	OECD	T-bill rate (OECD)
Russia	1995-2008	UN	lending rate (IFS)
South Afr.	1981-2008	UN	T-bill rate (IFS)
Turkey	1987-2006	UN	money market (IFS)
Developed Markets			
Australia	1981-2008	OECD	T-bill rate (OECD)
Austria	1990-2008	OECD	T-bill rate (OECD)
Canada	1981-2008	OECD	T-bill rate (OECD)
Denmark	1987-2008	OECD	T-bill rate (OECD)
Finland	1987-2008	OECD	T-bill rate (OECD)
France	1981-2008	OECD	T-bill rate (OECD)
Germany	1981-2008	OECD	T-bill rate (OECD)
Greece	1981-2008	OECD	T-bill rate (IFS)
Iceland	1988-2008	OECD	T-bill rate (OECD)
Ireland	1984-2008	OECD	T-bill rate (OECD)
Italy	1981-2008	OECD	T-bill rate (OECD)
Netherlands	1986-2008	OECD	T-bill rate (OECD)
New Zealand	1981-2008	OECD	T-bill rate (OECD)
Norway	1981-2008	OECD	T-bill rate (OECD)
Spain	1981-2008	OECD	T-bill rate (OECD)
Sweden	1982-2008	OECD	T-bill rate (OECD)
United Kingdom	1981-2008	OECD	T-bill rate (OECD)
United States	1981-2008	OECD	T-bill rate (OECD)

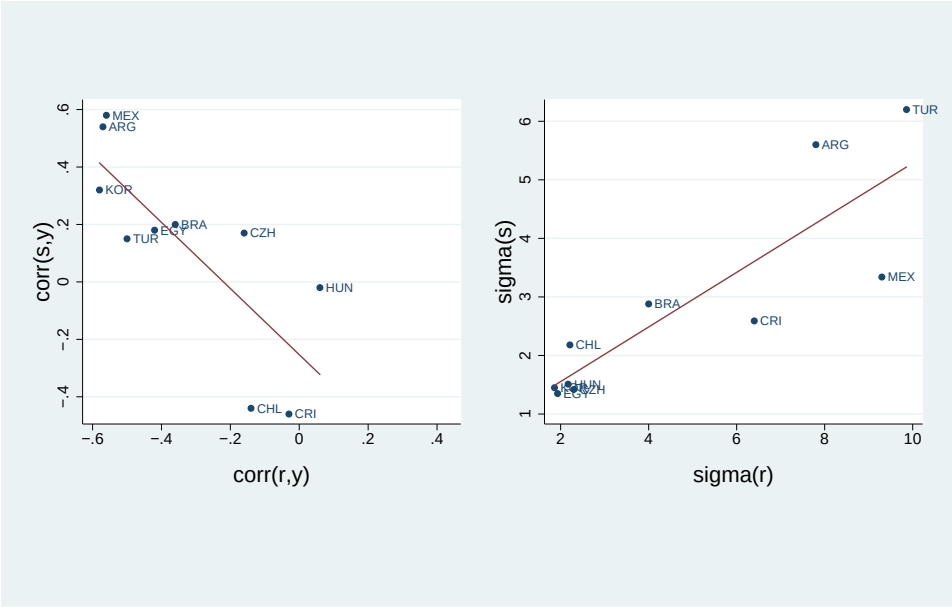
Note: *Compensation* is the compensation of employees in national accounts from income approach.

Figure A.1: Correlation of Labor Share and EMBI Interest Rates with Output



Note: corr(s,y) and corr(r,y) denote the correlation of labor share with output and of interest rate with output, respectively. Interest rate data cover 1994Q1-2005Q1 for many countries and constructed using EMBI spread data from Uribe and Yue (2006) except Argentina. Interest rate data for Argentina (1983Q1-2005Q1) come from Neumeyer and Perri (2005) until 2001Q2, we then extend the data using EMBI rates from Uribe and Yue (2006).

Figure A.2: Labor Share (Self-Employment-Adjusted) vs. Interest Rate Fluctuations



This figure updates Figure 1 with adjusted labor share using methods described in the text for emerging markets. See Table 4 for further information on which method is used for each country. See also Figure 1 for information on notations.

Appendix B

Appendices to Chapter 3

B.1 Data

Mexican Labor Variables:
The longest quarterly labor share for Mexico comes from the manufacturing sector, covering the period between 1987Q1-2008Q1. The source is the OECD. The correlation between cyclical component of labor share in manufacturing and that in the total economy is 0.86 at the annual frequency. Although it has a similar comovement with output, manufacturing labor share is 28% more volatile than that in the total economy, 4.5% and 3.5% respectively. Wages respresent hourly earnings in manufacturing from OECD monthly economic indicators (MEI). Hours are the proxy for the total hours worked in the total economy. They are constructed as hours per worker in manufacturing multiplied by the total civilian employment. Total hours worked and employment come from INEGI (industrial survey in manufacturing). Total employment is from Neumeyer and Perri (2005) for the period between 1987Q1 and 2001Q1. We then extend the data using the ILO labor statistics database until 2008Q1.

Other Variables for Mexico:
The source for interest rates, GDP, and GDP deflator is IFS. Interest rates are the average cost of borrowing in the total economy. We also use JP-Morgan EMBI+ data from Uribe and Yue (2006). Other variables for Mexico, such as consumption, net export, and investment come from OECD quarterly database.

Canadian Labor Variables:
Data on labor income share and employment are from OECD, and cover the whole economy. For wages, we have quarterly data for the overall economy from ILO. We take the same data period as in the case for Mexico (1987Q1-2008Q1).

Other Variables for Canada:
Interest rates are the short-term treasury bills from OECD. All other variables including GDP, GDP deflator, consumption, investment, and net exports are taken from OECD quarterly database.

B.2 Parameters for Mexico and Canada

In Chapter 3, we extend the baseline model by including labor adjustment costs to compare implications between Canada and Mexico in Section 3.3. The calibration for Mexico is explained in the text. Here we discuss the calibration for Canada.

We set discount factor to be equal to 0.99, which suggests a 4% annualized interest rate at the steady state. Labor curvature parameter is set to be 2 to match a Frisch elasticity of labor of 1, implying an elasticity of labor higher than in Mexico. This value is within the range of estimates used in the literature for developed markets. The capital exponent is set to be equal to 0.40 following the literature in business cycles. The elasticity of credit-income criterion to interest rates is assumed to be equal to 0.75, less than half of the value calibrated in Mexico. By doing this, we assume that Canada has better financial institutions; i.e, a less imperfect financial industry. Net foreign asset ratio at the steady state is calculated using the data on external asset positions from Lane and Milesi-Ferretti (2007). The rest of the parameters are the same as those for Mexico.

Table B.1: Parameter Values for Mexico and Canada

Name	**Symbol**	**Value**	
		Mexico	**Canada**
Discount factor	β	0.98	0.99
Utility curvature	σ	5	5
Labor curvature	υ	2.75	2.0
Labor weight	ξ	varies	varies
Capital exponent	α	0.43	0.40
Depreciation rate	δ	0.02	0.02
Wage bill paid in advance	θ	1 or 0.66	
Bond holding cost	κ	0.001	0.001
Capital adjustment cost	ϕ	varies	varies
Induced leverage	η	1.82	0.75
Net Foreign Debt / GDP	$\overline{\psi}$	-0.42	-0.25

Table B.2: Shock Processes

Mexico	
$\widehat{A}_t = 0.75\widehat{A}_{t-1} + \epsilon_t^a$ $\widehat{R}_t = 0.60\widehat{R}_{t-1} + \epsilon_t^r$	$\Sigma_{\epsilon_t\epsilon_t'} = \begin{pmatrix} 0.0134^2 & -0.000093 \\ -0.000093 & 0.0134^2 \end{pmatrix}$
Canada	
$\widehat{A}_t = 0.58\widehat{A}_{t-1} + \epsilon_t^a$ $\widehat{R}_t = 0.70\widehat{R}_{t-1} + \epsilon_t^r$	$\Sigma_{\epsilon_t\epsilon_t'} = \begin{pmatrix} 0.007^2 & 0.0000038 \\ 0.0000038 & 0.0025^2 \end{pmatrix}$

Appendix C

Appendices to Chapter 4

C.1 Data

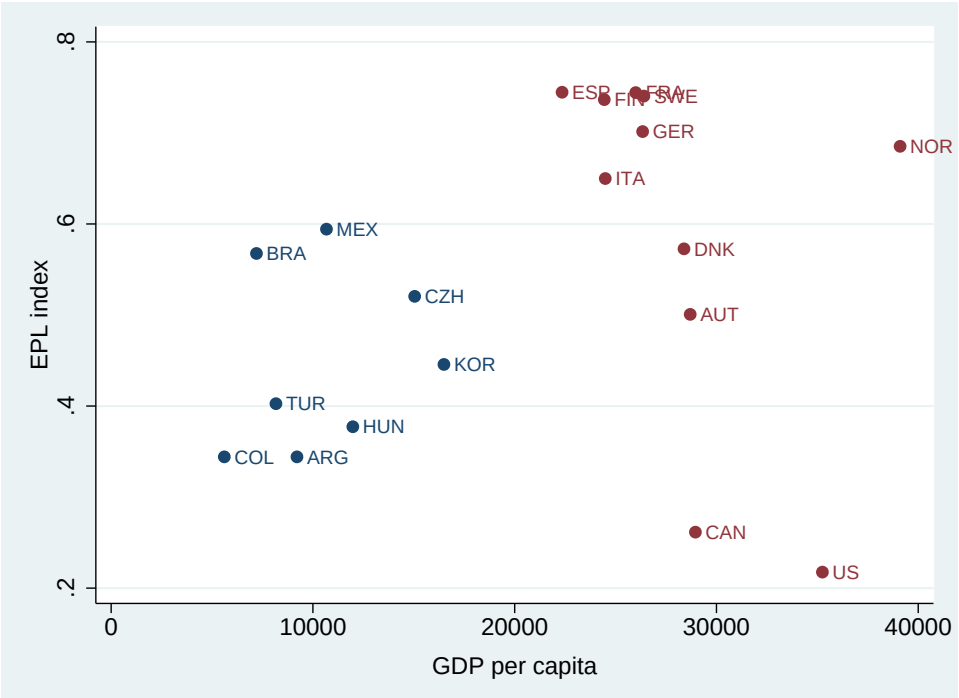
Table C.1 lists data sources for each economic variable and country. Since data from most of the emerging market start after 1980s, we take observations after 1981 for developed markets, as well. Hours represent total hours worked in manufacturing from industrial surveys conducted by national sources in emerging economies. We divide total hours by total employment in manufacturing to find hours worked per worker for these economies. We did the same for developed economies using total hours worked and employment in manufacturing from OECD or national sources. For both groups, hours are consistent with National Accounts in the sense that they both represent hours worked rather than normal or paid hours.

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

Table C.1: Data Sources

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

Figure C.1: EPL Index across EMs ad DMs



Note: Employment protection index comes from (see Botero et al., 2004). Higher numbers indicate more regulation of labor markets through employment laws, collective bargaining laws, and social security laws. GDP per capita (PPP adjusted in US dollars) in 2000 is taken for the income level.