Growth & Labour Market in Developing Countries

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Abstract

Economic development is deemed to be the process whereby a low-income nation improves the economic, political and social well-being of its citizen and transform into a modern industrialised nation. Although growth is vital and necessary for development, it is not a sufficient condition as development cannot be guaranteed. Over business cycle, growth fluctuates and this triggers movement between different labour market states. If there is positive growth, labour market tightness improves and with more vacancies available, job finding rate goes up whilst separation rate declines. All in all, more individuals move to employment which in turn improves living standard. Hence, in a way, development, growth and labour markets are all interconnected.

In this research project, first, we examine the impact of FDI on growth which is considered to be one of the primary determinants. In the literature, there is a debate on-going regarding the effectiveness of FDI on growth due to the conflicting empirical evidences. In addition to that, whilst it is claimed that BRICs over time have attracted quality FDI, there is no empirical support. Therefore, we take this opportunity to derive an augmented Solow model that accounts for different forms of capital investments as well as country-specific institutional characteristics and conduct panel estimations using 32 years of data on 54 developing countries to address those issues. Our main result is that FDI, GDI, human capital and infrastructure are all important factors and promote growth in developing countries. However, only FDI and GDI are more effective in BRICs whilst investment in human capital is detrimental to the growth of BRICs and as such in varying degrees contributed to the growth disparity.

Second, we elucidate the dynamics of the Brazilian unemployment for the period 2002 to 2014 in the presence of temporary and permanent contracts. In the literature, there has been many studies which address the gross flows, transition rates and unemployment dynamics but almost all focused on developed countries due to the lack of micro-data required for such investigation. The new Monthly Employment Survey (PME-Nova) was modified in 2002 for greater coverage and to make it more aligned for international comparison in line with ILO recommendation. With the availability of information on contracts, we take this opportunity to work out the worker flows and transition rates in a 6-state model and subsequently observe business cycle properties of these transition rates and their contribution to unemployment dynamics so as to compare our findings to those from other countries. Our main result is that transition rates involving permanent contracts are more important in explaining the cyclical fluctuations in unemployment and play a crucial role in job creation but even more so in job destruction.

Finally, we explore the dualistic nature of labour market in developing countries where there are different tiers of informal job such as informal employer, self-employed and informal salaried. In the literature, informal sector is often claimed to be an unregulated micro-entrepreneurial enterprise where individuals find work through word-of-mouth communication. However, this has never been explicitly modelled. Therefore, we take this opportunity to develop a matching model where the formal sector is characterized by search frictions whilst the informal sector is frictionless and perfectly competitive but comprising of different categories of informal job. Afterwards, this 5-state model is calibrated using the stylized facts from Brazil and a policy simulation is performed. Our main result is that a payroll tax aggravates labour market tightness, deter firms to open new vacancies, reduce search intensity and willingness of workers to leave non-formal

states and last but not the least, widens inequality. Therefore, tax plays an integral role in increasing non-employment as well as the size of informality.

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Chapter 1

Introduction

1.1 Motivation

Economic development is the process by which a low-income nation improves the economic, political and social well-being of its people and transform into a modern industrialised nation. According to Sen (2001), it is about creating freedom for people to choose their own destiny as well as eliminating obstacles to freedom such as poverty, lack of economic opportunity, corruption, poor governance, lack of education, lack of health etc. Growth is a vital and necessary condition for development, but it is not a sufficient condition as it cannot guarantee development.

We find that growth is influenced by many factors either directly such as human resources, natural resources, increase in capital employed/technological advancement etc. or indirectly such as institutions, efficiency of financial system, migration of labour and capital etc. Within the context of developing countries, foreign direct investment (FDI) is considered to be one of the leading factors responsible for growth where it provides the host country with foreign know-how which improves productivity and output by introducing efficient means of utilizing existing resources and absorbing unemployed ones (De Gregorio, 1992). FDI as a source of funding became especially important in the wake of the debt crises due to it being least volatile of all types of capital flow, leading to the volume and share of FDI inflow to escalate dramatically from a mere

17% per annum in the later part of 1980s to a staggering 125% per annum by the beginning of 1990s (Chuhan et al., 1996; Nair-Reichert & Weinhold, 2001).

It is argued that the emerging economies play a significant role nowadays, receiving more than half of the world's total FDI and producing about half of the global GDP measured at purchasing power parity (Peng, 2013). Among them BRIC (Brazil, Russia, India, China) countries have come under limelight because of their impressive growth rate. A number of studies reveal that if the incredible growth rate persists, in a span of 40 years, the combined economy has the potential to be larger than the G6 in US dollar terms (Wilson & Purushothaman, 2003; Cheng et al., 2007). However, to enjoy the benefits of sophisticated technology and knowledge spillovers, preferential programs and policies have to be in place that will not only attract quantity but quality FDI.

Although FDI complements local resources and provides a signal of confidence in investment opportunities leading to possible growth, proper screening policies need to be in place to ensure that FDI do not displace domestic firms and MNEs contribute new technologies or introduce new products to the country's basket of goods (Agosin & Mayer, 2000; Ndikumana & Verick, 2008). However, controversy arises as Aitken & Harrison (1999) in their influential study on Venezuela do not observe any evidence of positive technology spillovers from foreign firms to the ones domestically owned. Similar results associated to the ineffectiveness of FDI on growth are also found in Wheeler & Mody (1992), Haddad & Harrison (1993) and De Mello (1997).

Whilst FDI may promote growth in the developing countries, fluctuation in growth over the business cycle affects worker flow and in turn the labour market dynamics. For instance, if there is negative growth, there will be less demand for goods, firms will

produce less and will require fewer workers. On one hand, separation rate will likely go up as workers are laid off and on the other hand, job finding rate will likely fall as firms are reluctant to hire due to uncertainty, leading to reallocation of workers across the labour market states. Although the size and cyclical pattern of gross flows has often been studied for a growing list of developed countries (Hall, 2006; Petrongolo & Pissarides, 2008; Elsby et al. 2009; Blanchard & Gali, 2010; Smith, 2011; Silva & Vázquez-Grenno, 2013), there has only been a couple of studies on developing ones (Hoek, 2007; Bosch & Maloney, 2008).

There are two main reasons for this understudy. First, a large collection of data is required at the micro-level to account for population characteristics in order compute the correct flows of workers and jobs between different labour market states. But the problem is these are either missing or when are they are indeed recorded are often observed with errors. Second, the labour force survey is a meticulous task which is costly and time-consuming. Thus, with limited resource at disposal, the developing countries usually find it worthwhile to invest in other projects and not follow up on the survey, making it almost impossible to track the worker flow patterns between market states. However, as Ball et al. (2011) explains if the issues hampering this body of literature can be overcome, there is scope for much to be explored.

The labour market survey data in Brazil is obtained from the new Monthly Employment Survey (PME-Nova) conducted by IBGE. Any researcher has to consider either pre or post-2001 data due to the fact that PME underwent drastic modification in terms of concepts and methodology to account for greater coverage and changes in workplace such that it is more aligned for international comparability. For e.g. under the old methodology, IBGE

considered working age population to be those over the age of 15 compared to the new methodology where the age limit is raised to 18. Since most of the research till to-date has been using data prior to 2002, this is an opportunity to explore the most recent data from a developing country. Moreover, given the aforesaid modification of PME, it is possible to segregate the workers in terms of permanent and temporary contracts within a dualistic labour market framework. Previous researches have studied labour markets in a 3-state (Fujita & Ramey, 2009; Shimer, 2012) or 4-state set-up (Silva & Vázquez-Grenno, 2013) but focussed only on developed countries. Also, given the information on contracts, this enables a direct comparison of worker flows and transition rates to those reported from the developed countries.

Several studies have documented the presence of significant informality in developing countries. In a cross-country survey, Schneider (2005) estimates that the average size of informality is close to 42% in Latin America, 41% in Africa, 38% in Eastern Europe, 26% in Asia and 17% in Western Europe when measured as a percentage of GDP. Despite the advancement in technology and improvement in monitoring such level of informality is tolerated since on one hand, the sector provides a vital source of unregulated and flexible labour for firms which allow them to operate effectively and in turn increase their incentives to invest in new technology (Almeida & Carneiro, 2005) whilst on the other hand, intensifying the degree of coercion leads to higher unemployment as they are the opposite sides of the same coin (Boeri & Garibaldi, 2005)

Recent microeconomic evidence suggests that when it comes to developing countries, the volatility in unemployment from cyclical fluctuation are quite similar to those in developed countries but the reallocation over the business cycle are notable between

formal and informal jobs (Bosch & Esteban-Pretel, 2012). Following the aforementioned modification, PME-Nova is also able to segregate the workers in accordance to the dualistic nature of the labour market taking into account the different tiers of informal job. This can help in producing stylized facts with regards to Brazil which are incredibly imperative to policymakers and macroeconomists. On one hand, they help policymakers to monitor business cycles, detect turning points and assess labour market tightness whilst on the other hand, they help macroeconomists to calibrate a number of parameters.

In the existing literature, there are two school of thoughts regarding how one views informality considering the dualistic nature of labour market in developing countries. Some authors like Gong et al., (2004) and Fields (2009) view the informal sector as comprising of workers who cannot obtain the "good" formal job. It generally operates as a competitive market and therefore absorbs the excess workers from the formal sector. Alternatively, others such as Perry et al. (2007b) and Levy (2008) claim informal jobs as the consequence of voluntary choices made by workers in search of better pay or flexibility. This latter view has been supported by several empirical evidence, particularly, from Latin American countries that describes informality as an unregulated micro-entrepreneurial sector (Maloney, 2004; Mondragón-Vélez & Peña, 2010).

Following the early establishment of the search and matching model (Diamond, 1982; Pissarides, 1985; Mortensen & Pissarides, 1994) to understand the intricacies of the labour market dynamics and policy implication in developed countries, the focus nowadays has shifted towards developing countries where several extension have been made to explore the presence of informality (Fugazza & Jacques 2004; Boeri & Garibaldi,

2006; Albrecht et al. 2009; Dolado et al., 2009; Ulyssea, 2010; Bosch & Esteban-Pretel, 2012). Inspired by the work of Harris & Todaro (1970) on rural-urban migration, Zenou (2008) proposed a model where the formal sector is characterized by search frictions whilst the informal sector is frictionless and perfectly competitive. Although the author highlights the importance of self-employed and informal sector employers who start businesses by recruiting friends and relatives through the word-of-mouth communication, his model does not explicitly feature these.

Based on the discussion above, we are left with a few intriguing questions. Does FDI really promote growth? Did FDI play a significant role in the growth disparity between BRIC and non-BRIC countries? If not FDI, what other factors were responsible? How do you explain the dynamics of the labour market in Brazil? Which contracts are crucial in explaining the cyclical fluctuation in the Brazilian unemployment rate? Are the transition rates from Brazil similar to those from developed countries? Can a search and matching model be developed in a segmented labour market framework but with different tiers of informal job? The answers to these questions could be of importance to future researchers, macroeconomists and policymakers who strive to set policies to maintain a stable labour market, achieve growth and in turn promote economic development.

1.2 Contribution

Now that we have discussed our motivation for the research project, in what follows, we address several key issues and make a humble attempt to fill-in the gaps in existing literature.

In Chapter 2, we construct an augmented Solow model which provides a framework to combine the different forms of capital investment (namely, domestic, foreign and human) within the Cobb-Douglas production function; evaluates the competence of the factor inputs through the country-specific institutional characteristics such as trade openness, infrastructure, freedom etc.; mimics the gradual convergence compatible to a small open economy with partial capital mobility. This enables us to conduct an empirical study based on the neoclassical growth theory where the impact of FDI on growth in the developing countries is determined by correlated random effects. Moreover, we analyse the claim from literature that BRICs have been attracting quality FDI and as such responsible for the growth disparity. Finally, note that this is extensive research provided that we have investigated 32 years of panel data (i.e. from 1980 to 2012) on 54 developing countries.

In Chapter 3, we analyse the dynamics of the unemployment volatility in Brazil using the flow data from PME-Nova between 2002 and 2014. Our paper is one of the few that have conducted a flow analysis considering employment quadrility (employment: formal temporary, formal permanent, informal temporary and informal permanent). Moreover, to inspect the ins and outs of unemployment and more generally gross flows, we use data from PME-Nova that has been revised for greater coverage, changes in work place as well as better international comparability. This improvement provided us detailed information

on the types of employment contracts and thereby made it possible to carry out an in-depth analysis of the Brazilian labour market and compare the findings with those from other countries. Finally, we observe the contribution of the transition rates to fluctuations in the aggregate unemployment rate by setting up a 6-state model to account for temporary and permanent jobs in both formal and informal sector to resemble the labour markets of developing countries.

In Chapter 4, we develop a search and matching model with 5-states where the formal sector is characterized by search frictions whilst the informal sector is frictionless and perfectly competitive. Based on the empirical evidence, we incorporate 3 key features to the model. First, we allow for the coexistence of formal and informal jobs in the labour market where workers decide between being formal or informal. Second, given the importance of worker flows and transition rate within informal sector, we allow for workers to sort themselves into different tiers of job such as informal salaried, self-employed or informal employer based on individual opportunities or abilities. This is an extension of the work by Zenou (2008) who never truly models these features overtly but highlights the importance of self-employed and informal employer who start business by recruiting friends and relatives through the word-of-mouth communication. Third, we introduce the "non-overlapping property" which captures the idea that an informal employer will not move to non-employment due to the difference in maximum income. Finally, we conduct model calibration using the stylized facts from Brazil and perform a policy simulation.

1.3 Outline

Our research project contains 5 chapters in total. Following the brief introduction in Chapter 1, we now outline rest of the chapters.

In Chapter 2, we attempt to evaluate the importance of FDI as a driving force in the growth of developing counties over the period 1980 to 2012. More importantly, our interest is on a comparative study to explain the growth disparity between BRICs and non-BRICs based on the neoclassical growth theory. To achieve our goal, we construct an augmented Solow model and apply different estimation methodologies such as correlated random effects and feasible least square where in each step we add a growth determinant and observe the impact of FDI on growth.

In Chapter 3, we seek to elucidate the dynamics of the Brazilian labour market over the period 2002 to 2014. Given the information on contracts in the new Monthly Employment Survey (PME-Nova), we set-up a 6-state model explicitly considering employment quadrility (i.e. employment: formal temporary, formal permanent, informal temporary and informal permanent). To accomplish our goal, we conduct a flow analysis focusing on the gross flows, evaluate business cycle properties of the transition rates and represent contribution of those transition rates to fluctuations in the aggregate unemployment rate.

In Chapter 4, we try to take a closer look at the dualistic nature of labour market in the developing countries where there are different tiers of informal job such as informal salaried, self-employed and informal employer. To accomplish our goal, we develop a search and matching model with 5-states where the formal sector is characterised by search friction whilst the informal sector is frictionless and perfectly competitive, conduct

model calibration using data from Brazil over the period 2002 to 2015 and perform a policy simulation such as a tax reform.

Last but not the least, in Chapter 5 we summarise the conclusions from each chapter, discuss the limitations and provide the recommendations for future research.

Chapter 2

The influence of FDI on Economic Growth Disparity: A comparison between the BRICs and other Developing Countries

Abstract

In this paper, we attempt to evaluate the importance of FDI as a driving force in the growth of the developing countries. More importantly, our interest is on a comparative study to explain the growth disparity between the BRICs and non-BRICs based on the neoclassical growth theory. Using 32 years of panel data on 54 developing countries, our findings across different models and estimation methodologies unanimously advocate that FDI, GDI, human capital and infrastructure are particularly important for economic growth where the impact from GDI is most potent in the developing countries. What's more, FDI and GDI are more efficacious in BRICs whereas investment in human capital is detrimental to the growth of BRICs and as such in varying intensities have contributed to the growth discrepancy between the BRICs and non-BRICs. However, significance of FDI seems to be conditional on the presence of other growth determinants and as such the extent to which it boosts long run growth potential in a host economy for instance, via diffusion of technology and knowledge spillovers may depend on the degree of complementarities and substitutions between FDI and other country-specific factors and also on the ability and efficiency with which individual country can diffuse it to their nation productive systems.

2.1 Introduction

It has been widely argued that among the numerous factors influential to a country's economic growth, foreign direct investment (FDI) is one of the more fundamental ones. De Mello (1997) defines FDI as a composite bundle of foreign capital stock, know-how and technology that when invested in a host economy is likely to create a positive impact on growth which is expected to be manifold for instance, via capital accumulation and knowledge spillovers. De Gregorio (1992) highlights that by increasing capital stock, FDI enables a country to improve its productivity and output by introducing efficient means of utilizing existing resources and absorbing those that are currently unemployed. Hence, in a nutshell, FDI provides the additional resources to improve a country's economic performance and employment possibilities that may be unavailable in the host market otherwise. However, there are controversies at least in empirical aspect where this relationship often breaks down due to the lack of necessary data, conceptual design or concise testable hypothesis (Balasubramanyam et al., 1996)

Prior to the 1980s, high trade restrictions were the norm in most developing economies as they jostled to protect domestic firms from foreign competitions. However, with the drying-up of funds from commercial banks, they looked towards international market to bolster trade and economic growth (World Bank, 1997; Aitken & Harrison, 1999; Carkovic & Levine, 2005). Therefore, it led to a gradual relaxation of trade barriers and replaced by aggressive offer of subsidies and tax exemptions in an attempt to induce FDI and portfolio flows. The trade openness acted as a catalyst behind the rise in activities of the multinational enterprises (MNEs) which not only introduced crucial technological innovations but also a large share of world knowledge which filled the important "idea

gaps" between the developed and developing countries (Romer, 1993; Rappaport, 2000). Chuhan et al. (1996) and Nair-Reichert & Weinhold (2001) proclaim that FDI as a source of funding became especially important in the wake of the debt crises as it was less volatile than other types of capital flow. As a result, both the volume and share of FDI inflow escalated dramatically from a mere 17% per annum in the later part of 1980s, to a staggering 125% per annum by the beginning of 1990s. However, the extent to which this is growth enhancing depends on the degree of complementarities and substitutions between FDI and domestic investment and also on the ability and efficiency with which individual economy can diffuse it to their national productive systems (De Mello, 1999; Baskaran & Muchie, 2008).

In this research, we hope to shed some light on the significance of FDI as a driving force in the growth of developing countries. The emphasis will be on a comparative study to investigate the growth disparity between the BRICs[1] and non-BRICs by taking into consideration some of the key macroeconomic factors based on the neoclassical theory of economic growth. The rationale is driven by Figure A1 and A2 of Appendix A which depicts the evolution of average log GDP per capita and net FDI inflow over the past 32 years. Wilson & Purushothaman (2003) and Cheng et al. (2007) theorize a link between inward FDI and growth with BRICs over time possibly attracting quality FDI. However, we observe no conclusive evidence of a notable difference in net FDI inflow despite the incredible growth of the BICs (excluding Russia) between 1980 and 2012. It becomes more apparent with the inclusion of Russia (following its independence from Soviet Union in the late 1991) when comparing the BRICs and non-BRICs over the shorter time interval.

[1] BRIC is an acronym for Brazil, Russia, India and China – the fastest growing emerging markets in the world.

Hence, it begs the question, whether FDI is growth enhancing and more importantly, whether quality FDI is responsible for the growth disparity between the BRICs and non-BRICs. In this quest, we have only come across a few studies namely, Vijayakumar et al. (2010), Ranjan & Agrawal (2011) and Kaur et al. (2013) on the determinants of FDI in BRICs; Mercan et al. (2013) on the effect of trade openness in BRIC-T economies; Duan (2010) on the overall trends and industrial patterns of inward FDI in BRICs and Mlachila & Takebe (2011) on the impact of FDI outflow from BRICs to LICs. However, none of the past researches have focussed on the influence of inward FDI on the growth potential of the BRICs which is something we are interested in. Lim (2001) advocates that whilst substantial support exists for positive spillovers from FDI, there is no strong consensus on the associated causality or magnitude. Thus, we take this opportunity to empirically evaluate the relationship between FDI and growth by incorporating a model that controls for the country-specific institutional characteristics and uncover the possible factors inspirational for the growth disparity.

With that in mind, our contribution to the literature comes in the following ways. First, we derive an augmented Solow model which provides a framework to combine the different forms of capital investment namely, domestic, foreign and human within the Cobb-Douglas production function; evaluates the competence of the factor inputs through the country-specific institutional characteristics such as trade openness, infrastructure and freedom; mimics the gradual convergence compatible to a small open economy with partial capital mobility. Second, we conduct an extensive empirical study involving 32 years of panel data on 54 developing countries where the impact of FDI on growth is examined by correlated random effects (CRE). This technique is particularly useful when standard Hausman test cannot be exercised or where Hausman test rules in

favour of FE and the researcher is interested in the time-invariant parameters. Finally, we analyse the key growth determinants to explain the disparity in per capita GDP between the BRICs and non-BRICs. Our interest is particularly on the role of FDI since a greater influence in BRICs will provide support to the premise that the BRICs over time have effectively induced quality FDI which possibly contributed towards their successful growth.

Our results across different models and estimation methodologies are robust and unanimously supports the universal view that after controlling for other factors, FDI affects growth positively in the developing countries where on average a 1% increase accounts for 0.014% increase in per capita GDP. However, FDI on its own cannot influence economic growth which is consistent with Carkovic & Levine (2005). What's more, FDI has been more efficacious in BRICs compared to the developing economies in the sample and as such led to the disparity in per capita GDP equivalent to 0.064%. Thus, we provide empirical support to the premise that BRICs over time may have attracted quality FDI. In terms of the other growth factors, we perceive that gross domestic investment (GDI), education index and telephone lines per capita affect growth positively where the contribution to per capita GDP is 0.109%, 0.022% and 0.011% for every 1% increase in those respective regressors. However, only GDI and education index seems to play integral roles in the growth discrepancy. Specifically, the former has been far more effective in BRICs leading to the disparity in per capita GDP equivalent to 0.472% whilst the latter has been detrimental in BRICs leading to the disparity in per capita GDP equivalent to 0.005%. Moreover, there are other structural differences between these groups of countries as accentuated by the highly significant and positive country dummy. Judging from the magnitude and level of significance of the coefficients, we conclude that

GDI is the most potent growth determinant in the developing countries, followed by FDI, human capital and infrastructure respectively.[2]

We are not the first to investigate the role of FDI on economic growth which has been a topic of intense debate over the years. Some authors advocate a direct relationship where causation is predicted through statistical tests such as Granger Causality, Toda-Yamamoto etc. According to Basu et al. (2003), Choe (2003) and Chowdhury & Mavrotas (2006) a two-way link exists between FDI and growth which stems from the fact that increased FDI inflow promotes growth whereas brighter growth prospect attracts increased inward FDI, the latter being more apparent of the two. Evidence point towards a strong positive bidirectional causality in more open economies such as Malaysia and Thailand whilst long run causality is generally unidirectional from GDP to FDI in relatively closed economies such as Chile, implying trade and financial restrictions impede foreign funds. However, once the country panel heterogeneities are permitted, Nair-Reichert & Weinhold (2001) report on average unidirectional causality from FDI to GDP where the efficacy of FDI is larger in more open economies. Therefore, for a better understanding, country-specific studies are ideal since causality between FDI and growth is also country-specific.

Conversely, there are others who indicate towards an indirect relationship where FDI-led growth is triggered through other growth enhancing channels. Bevan & Estrin (2004), Tuman & Emmert (2004), Asiedu (2006) and Vijayakumar et al. (2010) highlight numerous factors that induce inward FDI into the host economies such as potential market size, per

[2] Ideally, we would like to identify whether the relationships between the dependant and independent variables are causal. However, in a quasi-experimental set-up like ours, it is almost always impossible to determine. Thus, we observe the association between the variables to get an idea about the true nature of these relationships. Understanding causation (when possible) and association are important since it allows for policies and programs that aim to bring about a desired outcome to be better targeted.

capita income, labour cost, infrastructure, trade openness, growth prospects, human capital, currency value, natural resource, economic stability and freedom etc. and in turn promote growth. Balasubramanyam et al. (1996) argue that the volume and effectiveness of incoming FDI is conditional on the country's trade policy regime i.e. whether it is following the export promoting (EP) or import substituting (IS) strategy. Specifically, EP strategy is when the average effective exchange rate on exports is equal to that on imports and thereby, the strategy is trade neutral or bias free. In contrast, IS strategy is when the effective exchange rate on import exceeds that on exports and as a result is biased in favour of import substitution activities.

Borensztein et al. (1998), Saggi (2002) and Li & Liu (2005) emphasize that although FDI is an important conduit for the transfer of technology, high productivity only holds when the host economy has sufficient absorptive capability of the advanced technologies and a minimum threshold stock of human capital. Noorbakhsh et al. (2001) proclaim that appropriate policies need to be formulated which improve local skills and build up human resource capabilities not only to attract the volume but also the quality and sophistication of FDI flowing into the host countries. Evidence indicates that with time, those relying on low-cost low-skill labour and natural resources will find it difficult to attract FDI to high value-added industries and in turn will suffer from sluggish economic growth. Alfaro (2003) documents that the influence of FDI varies greatly depending on the sector of investment. For instance, FDI in the primary sector affects growth negatively, in the manufacturing sector positively and in the service sector ambiguously. Thus, individual countries may employ differentiated schemes towards inducing different forms of FDI and even negative incentives to certain types, in particular, investment in natural resource.

Liu (2008) highlights that spillovers from FDI reduces short term productivity level but boosts long term rate of productivity growth in the domestic firms. The negative level effect is associated to the costly learning process whilst the positive rate effect is in accordance to the central theory of endogenous growth literature which identifies human capital or knowledge as the ultimate engine of economic growth. Agosin & Mayer (2000) and Ndikumana & Verick (2008) reveal that FDI acts as a catalyst for domestic investment by complementing local resources and providing a signal of confidence in investment opportunities leading to possible growth. However, screening policies need to be in place to ensure that FDI do not displace domestic firms and MNEs contribute new technologies or introduce new products to the country's basket of goods. Unless such can be achieved, the focus ought to be on the economic policies that foster the domestic component of total investment as liberal policies alone towards attracting MNEs and FDI are not always favourable for growth.

Hermes & Lensink (2003) and Alfaro et al. (2004) express that FDI promotes growth in the host economy conditional on the extent to which the financial market is developed. In studies on China – the largest FDI recipient, Chunlai (1997), Dees (1998) and Tseng & Zebregs (2002) imply that the magnitude of inward FDI from the sources into a host economy depends on its geographic position relative to the rest of the world. This is because transaction costs in terms of information gathering and familiarity within the local market are often crucial factors affecting the investment location decisions. Thereby, any country with larger market size, faster economic growth, higher per capita income, higher level of FDI stock and more liberalised trade policies represented by a higher degree of openness attracts relatively more FDI whilst higher efficiency wages and

greater remoteness deters. China's success over the past decades is down to meeting the necessary pre-conditions.

Finally, there is a third group of researchers who especially at firm-level point towards limited or no efficiency spillovers from FDI. Aitken & Harrison (1999) in an influential study on Venezuela observe almost no evidence of positive technology spillovers from foreign firms to those domestically owned between 1979 and 1989. Similar results are also derived in Wheeler & Mody (1992), Haddad & Harrison (1993) and De Mello (1997). Harrison (1996) reveals that FDI may adversely affect the performance of local firms by taking away part of their market share which compels them to spread their fixed cost over a smaller volume of production and as such the negative competition effect outweighs the positive effect of knowledge spillovers. However, that doesn't rule out positive spillovers over the long run through the generation of backward linkages (Adam, 2009). In case of Romania, Javorcik & Spatareanu (2008) assert that the negative effect of FDI arising from competition is lower in partially owned foreign investments as it is mitigated by greater knowledge dissipation within the sector.

Albeit microeconomic studies generally, though not uniformly, shed pessimistic views towards the growth effects of foreign capital, many macroeconomic studies find a positive link between FDI and growth. However, as Carkovic & Levine (2005) and Durham (2004) highlight once endogeneity and country-specific effects are fully controlled, FDI don't exert a positive impact on growth independent of other growth determinants. Herzer et al. (2008) proclaim that despite the dramatic rise in FDI inflow, total investment may rise below expectation and in some cases fail to rise completely if the majority of FDI goes to nations that already have substantial savings rates or if the growth limiting factors

of FDI obstruct the growth enhancing factors leading to small or no net effects both in the short and long run. Tsai (1994) theorises that although impact of FDI varies based on geographical differences, the causality nevertheless is overstated. In fact, Keshava (2008) portrays that economic policies aimed at stimulating domestic investment is a far more effective way to promote growth in the developing countries. Table A1 of Appendix A lists all the aforesaid empirical studies with key features.

The remainder of the paper is organized as follows. In Section 2.2, we discuss the theoretical model and its characteristics. Section 2.3 introduces the database and explains the adopted methodology. Section 2.4, we present the empirical results and statistical analysis. Section 2.5 offers policy implications, limitations of the study, suggestions for future research and concluding remarks.

2.2 Theoretical model

Based on the earlier studies of Mankiw et al. (1992), Grigorian & Martinez (2000) and Breton (2002), we implement an augmented Solow model to obtain a better explanation of growth in the BRICs and non-BRICs. The superiority of our model extends over its basic counterparts in that we take into account the effects of changes in the country-specific institutional characteristics which according to North (1990) plays an instrumental role in the country's long run economic performance. We consider a small open economy with partial capital mobility to mimic the gradual convergence towards the steady state. The key assumption of the model is that the physical capital can be used as collateral for external borrowing but not the human capital. Barro et al. (1992) proclaim that domestic residents own physical capital stock and may obtain part or all the financing of the stock by issuing bonds to foreigners. Alternatively, if FDI is allowed, the foreigners will own part of the physical capital stock rather than bonds. Henceforth, we explicitly split the domestic and foreign physical capital stock in the production function to analyse the importance of each in determining a country's path towards future growth.

On the above specifications, the Cobb-Douglas production function that is homothetic and strongly separable for a country i at time t takes the following form.

$$Y_{it} = K_{it}^{\alpha} F_{it}^{\lambda} H_{it}^{\varphi} (J_{it} A_{it} L_{it})^{1-\alpha-\lambda-\varphi}, \qquad 0 < \alpha + \lambda + \varphi < 1 \tag{1}$$

where Y_{it} is the output, K_{it} is the domestic physical capital stock, F_{it} is the foreign physical capital stock, H_{it} is the human capital stock, J_{it} is the country-specific institutional characteristics, L_{it} is the labour force, A_{it} is the labour augmenting world level of technological productivity, α is the share of national income accruing to domestic

capital stock, λ is the share of national income accruing to foreign capital stock, ϕ is the share of national income accruing to human capital stock and $1-\alpha-\lambda-\phi$ is the share of national income accruing to labour. We presume all types of capital, K_{it}, F_{it} and H_{it} to have a positive relationship with Y_{it}.

Since it is difficult to obtain the magnitude of ϕ, we have decided to follow the interpretation provided by Mankiw et al. (1992). They observe the US manufacturing sector and claim that the average wage is typically twice the minimum wage or somewhat larger. If the minimum wage is interpreted as the compensation to labour without education and the average wage as the compensation to raw labour endowed with average education, it suggests that around half of what a typical worker earns is really compensation to raw labour and the other half a return to human capital. Given a production function, where there is a separate market to services of human capital with marginal product compensation etc. the implied income share of human capital would then have to be ϕ. Thus, in our Cobb-Douglas production function, all the output elasticities α, λ, ϕ and $1-\alpha-\lambda-\phi$ are considered to be around $\frac{1}{4}$.

We acknowledge that J_{it} which evaluates the competence of factor inputs in a country's long run economic performance falls under 3 broad categories, namely, institutional quality measure, social capital and characteristics measure, political characteristics and instability measure. Within these classifications, Helliwell & Putnam (1995), Mauro (1995), Caselli, Esquivel & Lefort (1996), Levine & Zervos (1996), Temple and Johnson (1998) and Ng & Yeats (1999) examine numerous factors like trade policy, taxation, government intervention, regulation, voting, sport cultural association, industrial, housing, urban development instruments, number of revolutions, political assassinations,

riots and demonstration etc. as proxies for country-specific institutional characteristics and analyse their relationship to economic growth. After careful evaluation, our choice for J_{it} as depicted below is based on factors that are prominent in FDI-driven growth literatures as postulated by Fatehi-Sedeh & Safizadeh (1989), Rappaport (2000), Alfaro et al. (2004), Vijayakumar et al. (2010) etc. and availability of data.

$$J_{it} = T_{it}^{\eta} e^{\xi I_{it} + \psi C_{it}} \tag{2}$$

where T_{it} is the trade openness, I_{it} is the infrastructure, C_{it} is the civil and political instability, e is the exponential function, η is the elasticity whilst ξ and ψ are the semi-elasticities corresponding to the respective factors. J_{it} may increase or decrease with the changes in country-specific institutional characteristics affecting the ability of managers to convert resources into economic output. Among the factors representing J_{it}, we assert T_{it} and I_{it} to have a positive relationship with Y_{it} whilst C_{it} to have a negative one. Breton (2002) highlights that if government's share of consumption becomes too large, it may get involved in producing goods and services that are better provided by the private sector. Inefficiency arises as decision making will be driven by political reasoning rather than profit maximisation implying that the government's marginal contribution to GDP remains positive as its share of consumption increases up to a certain threshold after which it becomes negative. Nevertheless, we hypothesize that I_{it} and C_{it} are exponential in nature from the data.

Under the traditional Solow growth theory, the inputs of capital and labour are paid for their marginal products and the production function under all types of capital is similar. Labour and technology grow exogenously at the rates of n and g respectively as follows.

$$L_{it} = L(0)e^{nt} \tag{3}$$

$$A_{it} = A(0)e^{gt} \tag{4}$$

$A_{it}L_{it}$ is known as the effective units of labour and captures the idea that an hour of work today with the same equipment produces more output either due to an increase in the labour force, L_{it} or greater productivity, A_{it}. Hence, it grows at the rate of $n + g$ but in this case adjusted by the country-specific institutional characteristics, J_{it}. In an open economy, a country is small compared to the rest of the world and faces a constant real-world interest rate, r^w, which pegs the domestic interest rate, r_{it}. We consider that a constant fraction of aggregate national output is saved, S_{it} where GNP, Y_{it}^n is the sum of domestic output, Y_{it} and net output from foreign holdings, Z_{it}. Savings are utilized to acquire both K_{it} and Z_{it}. Note that the accumulation of human capital stock remains unchanged in the open economy setting, thus, any investment in H_{it} solely depends on Y_{it} as shown below. Also, we implicitly presume that foreign borrowings and reinvestments carried out by domestic residents are part of K_{it}, not F_{it} which only evolves in the presence FDI.

$$S_{it} = sY_{it}^n = s(Y_{it} + r^w Z_{it}), \qquad 0 < s < 1 \tag{5}$$

$$I_{it}^H = s_H Y_{it}, \qquad 0 < s_H < 1 \tag{6}$$

where s_H is the fraction of national output invested in human capital. Hence, the law of motion for the economy are given by the ensuing equations.

$$S_{it+1} = K_{it+1} - (1 - \delta)K_{it} + Z_{it+1} - Z_{it} \tag{7}$$

$$H_{it+1} = s_H Y_{it} + (1 - \delta)H_{it} \tag{8}$$

where δ is the rate of depreciation. We now rewrite the augmented Solow growth model in intensive form as follows.

$$y_{it} = k_{it}^{\alpha} f_{it}^{\lambda} h_{it}^{\varphi} J_{it}^{\,1-\alpha-\lambda-\varphi}, \qquad 0 < \alpha + \lambda + \varphi < 1 \tag{9}$$

where $y_{it} = \frac{Y_{it}}{A_{it}L_{it}}$, $k_{it} = \frac{K_{it}}{A_{it}L_{it}}$, $f_{it} = \frac{F_{it}}{A_{it}L_{it}}$ and $h_{it} = \frac{H_{it}}{A_{it}L_{it}}$. Under perfect competition, profits are maximised so firms employ capital and labour up to the point where their marginal products equal the real factor price, r^w. However, since the country is open to external borrowing and lending, we would expect that the real user cost of capital to be different for domestic and foreign physical capital. Debt literature suggests that excessive foreign debt and its service over time often creates tremendous domestic pressure which hurts investment and in turn leads to sluggish growth. Cohen (1991) documents that during the late 1980s as debt service ratio climbed from 9.7% to 19.6% for the Sub-Saharan Africa and 37.1% to 43.7% for the Latin America, investment plummeted from 8.3% to 4.5%, contributing to a record slow growth ranging between 0.4-1.4% compared to the sample mean of 4% for the group of LDCs. Sachs (1989) names this negative association as the "debt overhang problem". Based on the evidence, we establish the subsequent equations.

$$r^w = r_{it} - \zeta_{it} \tag{10}$$

$$r^w + \zeta_{it} + \delta = \alpha {k_{it}}^{\alpha-1} f_{it}^{\lambda} h_{it}^{\varphi} {J_{it}}^{1-\alpha-\lambda-\varphi} \tag{11}$$

$$r^w + \delta = \lambda {k_{it}}^{\alpha} f_{it}^{\lambda-1} h_{it}^{\varphi} {J_{it}}^{1-\alpha-\lambda-\varphi} \tag{12}$$

$$w_{it} = (1-\alpha-\lambda) A {k_{it}}^{\alpha} f_{it}^{\lambda} h_{it}^{\varphi} {J_{it}}^{1-\alpha-\lambda-\varphi} \tag{13}$$

where ζ_{it} is the risk of investing in foreign debt. It is believed that the stability of the host economy is an important factor to consider when assessing the risk associated to foreign debt. Using equations (8), (11) and (12), the steady states of k_{it}, f_{it} and h_{it} can be solved. However, we are concerned with the transition of the developing countries towards their respective steady states and not so much with the steady states themselves. Hence, we refrain from further deriving and utilize the production function in intensive form for the ensuing empirical analysis. Note that our derived model is instrumental to the study in 2 distinct ways. First, it establishes the idea that the investigation is rooted within a theoretical framework i.e. the neoclassical theory of economic growth. Second, it helps us to identify the expected relationships between the variables of interest and growth.

In the open economy literature with capital mobility, it is argued that funds flow to investment projects with the highest expected return to take advantage of the difference between the real world and domestic interest rate, until the returns are equalized. The introduction of new technology through FDI enables the host country to enjoy not only variety but also cost-effectiveness in the production process of the final output and in the long run alleviates living standard. Moreover, the country benefits from a broader capital share, increased per capita GDP and thereby, GNP, leading to a faster convergence towards its steady state. In contrast, growth in a closed economy is solely dependent on domestic investment, either in human or physical capital, in the absence of international markets.

Yet, the extent to which the factor inputs contribute to a country's long run economic performance ultimately depends on the country-specific institutional characteristics. Albeit the process by which government policy change, corruption or institutions impact

growth is not overt in growth models, it is apparent from the production function that any impact occurs either through its influence on the investment rates or total factor productivity (TFP). For instance, if the government takes investment and other policy decisions based on favouritism rather than public welfare or firms take action to avoid paying bribes or due to lack of property rights, etc. Overall, the country operates below their maximum production possibility frontier and generates less output than it would otherwise, resulting in a possible difference in growth dynamics as observed between the BRICs and non-BRICs. Hence, inclusion of the country-specific institutional characteristics helps to better explain the disparity in the growth of economies.

2.3.1 Data

For the research, we have collected annual data between 1980 and 2012 from the World Bank database of World Development Indicators for the BRICs and 50 other developing economies, consisting of a group of 15 from Asia & Middle East, 19 from North & Sub-Saharan Africa and 16 from Central & Latin America as listed in Table A2 of Appendix A. Shafaeddin (2005) explain that trade liberalization and market-oriented economic reforms started in most developing countries in the early 1980s and it came in 3 stages. The move towards dynamic industrial and trade policies were first initiated by the countries in Asia, followed by the reform programs designed and dictated through the international financial institutions (IFIs) in Africa and later in Latin America. As a result, our investigation is conducted from 1980 onwards.

One of the major drawbacks of such macroeconomic study is the lack of data availability for essential country variables over extended time span. This is particularly prevalent for the poorer economies and it is not until the mid/late 1980s that most statistics in our sample are recorded. To observe the impact of FDI on economic growth, GDP per capita is selected as the dependant variable (y_{it}) and net FDI inflow (f_{it}) as the key independent variable. We also control for other variables that influence growth such as GDI (k_{it}), education index (h_{it}) as a proxy for human capital and institutional characteristics like trade openness (T_{it}), telephone lines per capita (I_{it}) as a proxy for infrastructure and freedom rating (C_{it}) as a proxy for civil and political instability. Table A3 of Appendix A summarizes the full set of variables utilized in the econometric analysis and the various sources from which data is accumulated.

Our choices for the aforementioned proxies are explained as follows. First, Bougheas et al. (2000) reveal that unlike rival indicators, telephone lines per capita incorporate the direct impact of production cost and as such is less susceptible to comparability issues across the economies. Thus, we opt for telephone lines per capita to represent I_{it}. Second, the Freedom House is an NGO that conducts research and reports annually on each nation's democracy, political freedoms, human rights and civil liberties. Hence, it made all the sense to characterize C_{it} with the freedom rating. Third, according to Breton (2002), the average level of schooling assumes that within a country all years of education have the same investment cost which may underestimate the difference in the relative quality of human capital between the countries. Alternatively, public spending on education is even more dubious which may overestimate the true value of investment in corrupt economies where funds are often diverted elsewhere. In order to overcome these problems, we progress with the UN's education index for h_{it} which is a weighted average of the expected and mean years of schooling. Finally, all data are converted to 5-year averages to dilute cyclical influence and obtain greater variability.

Table A4, A5 and A6 of Appendix A documents the summary statistics for all countries, BRICs and non-BRICs respectively over the period 1980 to 2012. We perceive that there are considerable cross-country variations in the sample. For instance, the average growth in GDP per capita (lny_{it}) is 7.14% for all countries with a standard deviation of 0.97. However, the BRICs are above average (7.29%) with a standard deviation of 1.18 whilst the non-BRICs are similar to the average (7.13%) with a standard deviation of 0.95. Max lny_{it} attained by the BRICs is 8.74% and Min is 5.39%. In contrast, Max lny_{it} attained by the non-BRICs is 9.00% and Min is 4.99%. With regards to the physical capital, we observe that the average growth in FDI (lnf_{it}) and GDI (lnk_{it}) are 0.02% and 2.97%

correspondingly with the former being more volatile over the past 32 years. Interestingly, the BRICs are significantly below average for lnf_{it} (-0.19%) whilst above average for lnk_{it} (3.20%). Considering that these are the fastest growing emerging markets in the world, one possible explanation may be that the growth in FDI has been unable to keep pace with the exponential growth in GDP. Conversely, the non-BRICs are similar to the average for both lnf_{it} (0.04%) and lnd_{it} (2.95%).

In terms of the human capital, we find that the average education index (h_{it}) is 0.44 (on a scale between 0 and 1) where 1 indicates perfect education attainment whilst the average growth in trade openness (lnT_{it}) is 4.08% for all countries concerned. Given that the BRICs are above average for h_{it} (0.49) compared to the non-BRICs who are slightly below (0.43), it sheds some light on the absorptive capabilities of the BRICs. However, we find that the BRICs are below average for lnT_{it} (3.35%) whilst the non-BRICs are above average (4.14%). Finally, the average number of telephone lines per capita (I_{it}) and freedom rating (C_{it}) for the sample countries are 4.97 and 4.16 respectively, where for the latter, 1 indicates most politically stable economy (on a scale between 1 and 7). We observe that the BRICs are notably above average for I_{it} (9.48) but below average for C_{it} (4.07). Conversely, non-BRICs are below average for I_{it} (4.61) but above average for C_{it} (4.17). With better infrastructure complemented by lesser civil and political unrest, it is not surprising that over time the BRICs have enjoyed better living standards.

Table A7 of Appendix A represents the correlation matrix which shows the relationship among the variables over the period 1980 to 2012 where * indicates the significance of the correlation coefficient at different levels. It is worth noting that none of the coefficients are substantially high to cause multicollinearity. We perceive that overall

Δlny_{it} has a positive correlation with other variables and in most cases highly significant. It makes perfect sense, since investment, trade and infrastructural development play instrumental roles in economic growth and thereby, raises a country's per capita GDP. However, it is rather ambiguous that so does social and political instability. Although, Δlnk_{it} also has a positive relationship with others (expect for Δlnf_{it}), it is merely significant for Δlny_{it}, Δh_{it} and ΔlnT_{it}. Conversely, Δlnf_{it} is positively correlated and significant for Δlny_{it} and ΔlnT_{it} whilst negatively correlated and significant for Δh_{it}. Growth theory implies that whilst improved infrastructure and trade induces domestic investment as well as FDI (often through MNE settlement in the host economies), any unrest causes disruption, dampens trade and discourages investment, particularly FDI. Interestingly, FDI has a negative relationship with GDI which may be due to the crowding out effect as discussed in Adams (2009).

With regards to Δh_{it}, a positive correlation is observed with other variables (except for Δlnf_{it} and ΔC_{it}) which are predominantly significant. One possible way to explain the negative linkages is that these developing countries are poor with often limited resources and as such encounter greater trade-offs when setting policies to either develop human capital or other sectors of the economy to attract inward FDI. This is further aggravated by civil and political instability which they usually experience. Finally, we perceive that both ΔI_{it} and ΔlnT_{it} generally have positive relationship with others and mostly significant. On the other hand, ΔC_{it} is negatively correlated with other variables (except for Δlny_{it} and ΔI_{it}) and almost never significant. Note that the highest significant correlation is 0.33 found between Δlnk_{it} and ΔlnT_{it} whilst the lowest significant correlation is 0.10 observed between Δlny_{it} and ΔC_{it}.

2.3.2 Empirical model

In this study, our aim is to evaluate the influence of different types of capital investment, notably FDI in the growth of developing economies. In addition, we wish to identify the possible causes behind the growth disparity observed between the BRICs and non-BRICs over the period 1980 to 2012. Hence, at this juncture, we substitute the country-specific institutional characteristics, J_{it} by the 3 proxies namely, T_{it}, I_{it} and C_{it} from equation (2) into the production function in equation (9) which gives us the following.

$$y_{it} = k_{it}^{\alpha} f_{it}^{\lambda} h_{it}^{\varphi} \left(T_{it}^{\eta} e^{\xi I_{it} + \psi C_{it}}\right)^{1-\alpha-\lambda-\varphi}, \qquad 0 < \alpha + \lambda + \varphi < 1 \tag{14}$$

Applying natural logarithms to both sides of equation (14), we can obtain the subsequent model of national output per effective labour.

$$lny_{it} = \alpha lnk_{it} + \lambda lnf_{it} + \varphi lnh_{it} + \rho\eta lnT_{it} + \rho\xi I_{it} + \rho\psi C_{it} \tag{15}$$

where $\rho = 1 - \alpha - \beta - \phi$. For our convenience, we then convert equation (15) into the unobserved effects model as shown below.

$$lny_{it} = \beta_0 + \beta_1 lnk_{it} + \beta_2 lnf_{it} + \beta_3 lnh_{it} + \beta_4 lnT_{it} + \beta_5 I_{it} + \beta_6 C_{it} + \alpha_i + \mu_{it} \tag{16}$$

where the coefficients β_1, β_2, β_3 and β_4 are the output elasticity whilst β_5 and β_6 are the output semi-elasticity of the factor inputs and institutional characteristics, β_0 is the intercept, α_i is the unit-specific effect for all time-invariant unobserved heterogeneity whilst μ_{it} is the idiosyncratic error for all unobserved factors that vary over time and may affect output, y_{it}. Finally, we take first difference of equation (16) and yield the following.

$$\Delta lny_{it} = \delta_0 + \beta_1 \Delta lnk_{it} + \beta_2 \Delta lnf_{it} + \beta_3 \Delta lnh_{it} + \beta_4 \Delta lnT_{it} + \beta_5 \Delta I_{it} + \beta_6 \Delta C_{it} + \Delta\mu_{it} \qquad (17)$$

where Δ denotes the change in the variables from t_0 = 1980 to t_1 = 1985 and so on. Note that the final transformation has removed the unit-specific effect, α_i from equation (17). Thus, as long as the error term is uncorrelated with the new independent variables, the estimators should be unbiased. Differentiating the variables as above has 3 key benefits. First, it eliminates the unobserved heterogeneity in the estimated data. Second, it gets rid of unit roots. Third, it explicitly enables us to observe how chances in the stock of capital per effective labour as well the level and growth rate of country-specific institutional characteristics affect the changes in per capita GDP.

In the growth literature, cross-country panels are frequently estimated through fixed effects (FE) or random effects (RE) because they are generally more efficient when dealing with heterogeneity bias. Allison (2005) implies that the panel models offer better estimates than conventional OLS in the sense that it adjusts for the within-person correlation in the repeated measurements of the dependant variable and rectifies the downward bias in standard errors due to the dependence in the multiple observations for each variable. Choosing between FE and RE can be difficult and the decision is often based on the economic intuitions as well as data at hand. For instance, let us consider the ensuing general model.

$$z_{it} = \delta + \beta X_{it} + \alpha_i + u_{it} \qquad (18)$$

where i denotes country (cross-sectional dimension), t denotes time (time series dimension), δ is a common constant, X_{it} is the vector of the explanatory variables, α_i is the time-invariant parameter and u_{it} is the idiosyncratic error.

FE assumes that α_i and X_{it} are independent of u_{it} for all i and t but there is arbitrary correlation between α_i and X_{it}. As a result, time-demeaning transformation is applied to obtain unbiased and consistent estimators. The only pitfall is that with any variable constant over time for all i gets eradicated and one degree of freedom is lost for each cross-sectional observation i. Nevertheless, Baltagi (2003) explains that this corollary issue of loss in degrees of freedom can be avoided if α_i is instead presumed to be random. This is where RE comes in which assumes that X_{it} are uncorrelated with both α_i and u_{it} for all i and t. Hence, α_i is no more eliminated (as it will lead to inefficient estimation) and instead considered as part of the composite error term, $\varepsilon_{it} = \alpha_i + u_{it}$. Although ε_{it} becomes serially correlated, generalized least square (GLS) ensures that there is efficient estimation.

Another key advantage of RE over FE is that it allows for X_{it} to be constant over time. However, as Wooldridge (2008) argues this notion is rather vulnerable and FE which allows for arbitrary correlation between α_i and X_{it} is widely thought by researchers to be a convincing tool for estimating ceteris paribus effect and policy analysis. Despite that if the full set of RE assumptions hold, the estimator becomes asymptotically more efficient than pooled OLS, first difference and even FE. The choice between FE and RE is guided by the Hausman test where H_0 ruminates both models to be systemically close and consistent whilst H_1 considers only RE to be biased and inconsistent. Unfortunately, the standard Hausman test cannot be implemented if either the robust standard errors are

applied or standard errors are clustered to control for heteroskedasticity and serial correlation respectively which are often common problems associated to macro panels with long time series (usually over 20-30 years). On top of that, if the Hausman test rules in favour of FE, all time-invariant indicators will be lost which may be of interest for the study.

To address the aforementioned challenges, CRE is employed which basically allows us to unify both FE and RE estimation techniques to analyse the cross-country growth regressions. Recall that RE is biased if α_i is correlated with X_{it}. The intuition behind CRE comes from Mundlak (1978) who asserts that if α_i is correlated with X_{it}in period t, then it will also be correlated with X_{it} in period s, where $t \neq s$. Hence, all the realisations of the $X's$ (i.e. leads and lags of X_{it}) ought to be included in the regression for unbiased estimation. Specifically, α_i is decomposed into 2 components where it is deemed that one part is correlated with the observable covariates (including $X_{it}'s$ from all time periods) whilst the other part is truly random (i.e. uncorrelated with X_{it} for all t). Given the assumption, equation (18) can be re-written as follows.

$$z_{it} = \delta + \beta X_{it} + \gamma \overline{X}_i + \omega_i + u_{it} \tag{19}$$

where $\overline{X}_i = T^{-1} \sum_{t=1}^{T} X_{it}$ is the vector of the time averages, ω_i is the true random effect and γ is the arbitrary correlation between α_i and X_{it}. Wooldridge (2018) shows that a simple regression-based fully robust Hausman test can be applied afterwards to effectively choose between FE and RE. The idea comes from the fact that if equation (19) is estimated by RE, the value of β is equivalent to that of FE estimate. However, if we impose $\gamma = 0$, the obtained β value is that of RE estimate. Thus, the robust Hausman test

to reject RE in favour of FE is just a fully robust Wald test of $H_0: \gamma = 0$ after RE estimation of the augmented equation. Furthermore, CRE retains all time-constant indicators whilst delivering those FE estimates on the time-varying covariates and as such provides an alternative route to researchers who are interested in the predictive capability of the time-invariant variables in situations where the Hausman test rules in favour of FE.

2.4 Results and statistical analysis

On the basis of the prior discussions, we adopt CRE to analyse the panel data and regress equation (17) in difference where by default the coefficients are that of FE estimate. Initially, only the influence of FDI on per capita GDP is considered as in Model 1 (M1), presuming the base year to be 1980. This is followed up by the sequential adding of the control variables so that by M6 we have the complete model. Next, alternative panel models are introduced that are variations of the original to explain the growth disparity between the BRICs and non-BRICs. For instance, in M7, a county dummy is implemented whilst from M8 to M13, numerous interaction terms are employed. Table A8 & A9 of Appendix A summarise the panel estimations. Wooldridge (2008) argues that there is a possibility for error variance to change over time giving rise to heteroskedasticity in the error term but the robust standard errors and test statistics are nevertheless valid. Last but not the least, feasible generalized least square (FGLS) is applied to the panels since asymptotically it is more efficient when series exhibit heteroskedasticity. However, note that throughout the investigation, we substitute Δlnh_{it} by Δh_{it} since h_{it} is an index with low variability and as such log differencing will prevent the variable to have any notable effect. Also, when interpreting the coefficients, we convert the output semi-elasticities into elasticities for the purpose of comparison. [3]

We start with M1 where Δlnf_{it} is the only regressor and takes advantage of all the available data points (288). It yields an estimated coefficient of 0.006 implying that in the sample developing countries on average a 1% an increase in FDI accounts for 0.006% increase in per capita GDP. However, the coefficient is not significant which in line with

[3] In a log-linear relationship, the slope coefficient, β i.e. semi-elasticity is given by $\frac{\Delta lnY}{\Delta X} = \left(\frac{1}{Y}\right)\left(\frac{\Delta Y}{\Delta X}\right)$. Therefore, to obtain elasticity, we simply multiply the slope coefficient by $\overline{X}$.

Carkovic & Levine (2005) suggest that FDI on its own cannot influence economic growth. Thus, one by one the control variables are introduced to observe the change in magnitude and significance of FDI in the presence of other growth determinants. We perceive that the coefficient on Δlnf_{it} increases to 0.009% with the addition of Δh_{it} in M2, increases to 0.010% with the inclusion of Δlnk_{it} in M3, increases to 0.012% with the addition of ΔlnT_{it} in M4, increases to 0.014% with the inclusion of ΔI_{it} and remains stable at 0.014% with the addition of ΔC_{it} in M6. Notice that FDI is almost always significant when in the company of other growth factors except for in M2 when it barely lies outside the 10% criterion.

Thereafter, the focus is shifted towards the other forms of capital to evaluate their roles in the growth of developing economies. We observe that Δh_{it} affects growth positively in support of the hypothesis that human capital and knowledge are the ultimate engines of growth but it is generally not significant. The exception is M2, where the estimated coefficient indicates that on average a 1% increase in education index accounts for 0.025% (i.e. 0.763*0.033) increase in per capita GDP. Likewise, Δlnk_{it} affects growth positively and with a coefficient that not only is highly significant but also conjures the strongest impact across the estimated models. We perceive that on average a 1% increase in GDI accounts for 0.103% increase in per capita GDP in M3 which increases to 0.121% in M4, decreases to 0.119% in M5 and remains the same in M6. Looking at the magnitude of these effects, it may well be argued that domestic investment is far more effective in fostering growth as proposed by Tsai (1994) and Keshava (2008).

As we continue adding other growth determinants between M4 and M6, there is a slight reduction in the number of observations but it is compensated by a considerable

improvement in the model's goodness of fit. With regards to the variables representing country-specific institutional characteristics, ΔlnT_{it} is found to affect growth negatively but the coefficient is never significant. An explanation on trade openness is put forward by Spilimbergo et al. (1999) and Rodrik et al. (2004) stating this puzzling sign to represent the adverse effects of trading in primary products. Specifically, if the total trade is broken down into manufacturing and non-manufacturing components, it the latter that enters as negative. On the other hand, ΔI_{it} affects growth positively and the coefficient is generally significant across the estimated models. We observe that in the sample developing economies on average a 1% increase in telephone lines per capita accounts for 0.010% (i.e. 0.007*1.381) increase in per capita GDP in M5 as well as in M6. Also, ΔC_{it} seems to affect growth positively but again the coefficient is not significant.

At this juncture, some variations of the complete model are employed to observe if there are any fundamental changes to the estimates. We find that only the country dummy, BRIC and interaction terms, Δlnf_{it}*BRIC, Δlnk_{it}*BRIC and Δh_{it}*BRIC are in general significant between M7 and M13 to explain the growth difference between the BRICs and non-BRICs. To be exact, there is a positive coefficient on Δlnf_{it}*BRIC and Δlnk_{it}*BRIC suggesting that both FDI and GDI has been instrumental in the growth of BRICs where on average the discrepancy in per capita GDP range between 0.057-0.064% and 0.457-0.472% respectively. Furthermore, there are other structural differences (not in consideration) that have contributed to the growth disparity as accentuated by the positive coefficient on country dummy. However, the negative coefficient on Δh_{it}*BRIC seems to imply that human capital has a detrimental effect on the growth of BRICs where

on average the difference in per capita GDP range between 0.005-0.013%[4]. Meulemeester & Rochat (1995) assert that when resources are scarce, over-expansion of the education system or some of its components (i.e. primary education versus higher education in less developed countries) can adversely affect growth.

Note that those regressors significant in M6 have maintained their level of significance, signs and to some extent magnitude consistently between M7 and M13, reinforcing their importance in economic growth. The exception is Δh_{it} which remains significant from M9 onwards. For our key variable, we observe that on average a 1% increase in Δlnf_{it} accounts for 0.014% increase in per capita GDP steadily across the estimated models. However, on average the contribution to per capita GDP seems to vary between 0.108-0.118% with regards to Δlnk_{it}, 0.022-0.023%[5] with regards to Δh_{it} and 0.010-0.011%[6] with regards to ΔI_{it} for every 1% increase in those regressors. Table A10 of Appendix A depicts the robust Hausman test on M13 which as discussed in Section 2.3.2 is a fully robust Wald test to analyse the validity of our FE estimates. The test is highly significant at 1% and H_0 is rejected in favour of FE over RE. This implies that only FE produce estimates that are unbiased and consistent. In addition, we apply robust standard errors to control for heteroskedasticity, cluster standard errors by country to control for serial correlation and include year dummies to capture the influence of aggregate trends in each of the aforesaid regressions.

[4] The interval is computed using the technique discussed in footnote 3 i.e. (1.806*0.003)-(4.168*0.003)% = 0.005-0.013%.
[5] The interval is computed using the technique discussed in footnote 3 i.e. (0.680*0.033)-(0.687*0.033)% = 0.022-0.023%.
[6] The interval is computed using the technique discussed in footnote 3 i.e. (0.007*1.381)-(0.008*1.381)% = 0.010-0.011%.

Finally, we espouse FGLS in M14 to evaluate the robustness of our findings. Overall the coefficients display the same signs as those in M13 but with a few differences related to the level of significance and magnitude. To be specific, our fundamental variable remains significant and we perceive that on average a 1% increase in Δlnf_{it} accounts for 0.009% increase in per capita GDP. However, among the original control variables from M6, only Δlnk_{it} and for the first time ΔC_{it} are found to be significant where on average the contribution to per capita GDP is 0.090% and 0.001% (i.e. 0.098*0.013) respectively for every 1% increase in those regressors. Although GDI is undoubtedly the most dominant factor in nurturing growth, freedom rating seems to imply that growth may be sustainable in spite of social and political unrest but the evidence for this latter argument is rather insufficient. Furthermore, we observe that both the country dummy, BRIC and interaction terms, Δlnf_{it}*BRIC and Δlnk_{it}*BRIC are highly significant which reinforce that along with other structural differences (not in consideration), FDI and GDI has played integral role in the growth disparity between the BRICs and non-BRICs where on average the discrepancy in per capita GDP is 0.067% and 0.391% respectively.

In view of the robust results obtained across different models and estimation methodologies, the choice of a preferred output is relatively harmless. Given that model 13 provides the best fit to the data with estimated coefficients that are mostly significant, if we are to choose a set of results, those from M13 would be our choice.

2.5 Conclusion

In this paper, we have carried out an extensive empirical study involving 32 years of panel data on 54 developing countries in an attempt to shed some light on the drawn-out debate regarding FDI's impact on the growth potential of the developing countries. Based on the neoclassical theory of economic growth, our empirical model is derived from an augmented Solow model that incorporates 3 types of capital investment namely, domestic, foreign and human along with the country-specific institutional characteristics for instance, trade openness, infrastructure and freedom as inputs in the Cobb-Douglas production function. We go further and examine whether FDI has been more effective in BRICs and eventually responsible for the growth disparity between BRICs and non-BRICs observed in the world today. Our findings from the research are insightful for governing authorities and policy makers, particularly from the developing economies since emphasis is often put on implementing various programs and domestic policies for the benefit of foreign investment, often at the expense of domestic ones, believing all along that FDI is the primary source of higher growth and knowledge spillovers.

Our results across different models and estimation methodologies are robust and unanimously supports the universal view that after controlling for other factors, FDI positively affects growth in the developing countries. We observe that on average a 1% increase in FDI accounts for 0.014% increase in per capita GDP. However, FDI on its own cannot influence economic growth which is consistent with Carkovic & Levine (2005). Moreover, all models agree to the fact that FDI has been more effective in BRICs and as such led to the disparity in per capita GDP equivalent to 0.064%. Thus, we provide empirical support to the premise by Wilson & Purushothaman (2003) and Cheng et al.

(2007) that BRICs over time may have attracted quality FDI. Singh & Jun (1995) explain that a more intensive research is required to fully grasp the causes behind this growth discrepancy since historically, economies that have high or low FDI inflows are structurally different. Nevertheless, we believe that ultimately the outcome may depend on the degree of complementarities and substitutions between FDI and other country-specific factors that are instrumental towards growth.

With regards to the other forms of capital investment, we observe that not only GDI affects growth positively but it also conjures the strongest impact where on average a 1% increase in investment accounts for 0.109% increase in per capita GDP. What's more, all models confirm that GDI has been far more efficacious in BRICs and as such led to the disparity in per capita GDP equivalent to 0.472%. Comparing these coefficients with those from FDI, it may be argued that GDI is more potent in fostering growth in the developing countries. In fact, the relationship between FDI and growth in theory may be overstated as emphasized by Tsai (1994) and Keshava (2008). Similarly, we perceive that education index affects growth positively in support of the hypothesis that human capital and knowledge are the ultimate engines of growth. However, across the various specified models, the contemporaneous effect is merely found to be significant half of the times where on average a 1% increase in education index accounts for 0.022% increase in per capita GDP. What's more, human capital seems to have a detrimental effect on the growth of BRICs leading to the discrepancy in per capita GDP equivalent to 0.005%.

In terms of the country-specific institutional characteristics, we observe that across the different specifications, infrastructure is consistently significant and affects growth positively where on average a 1% increase in telephone lines per capita accounts for

0.011% increase in per capita GDP. However, neither freedom rating nor trade openness seem to have a stable relationship with economic growth. The positive coefficient on the former implies that growth may be sustainable in spite of social and political unrest but the contemporaneous effect is only significant for FGLS. The inconclusive evidence may be due to the lack of variation in the time series – a major drawback documented by early researchers who have used rating as proxy. Unfortunately, there wasn't a suitable alternative that could cover our entire period of interest. The negative coefficient on the latter, although inconsistent with the export-led growth theory, may be interpreted as the adverse effects of trading in primary products. Spilimbergo et al. (1999) and Rodrik et al. (2004) reveal that if the total trade is broken down into manufacturing and non-manufacturing, it is the latter that enters as negative but again the contemporaneous effect is never found to be significant.

To conclude, the research project to us seems to be a success. Utilizing a variety of models and estimation techniques, we have not only determined the influence of FDI on growth in the developing countries but also its significance along with other factors in explaining the growth discrepancy between the BRICs and non-BRICs. However, since both CRE and FGLS approaches depict only the average effect, country-specific studies may be more ideal to ascertain the relevant determinants in their respective growth. Moreover, we observe that the country dummy is consistently significant and affect BRICs positively implying that there are other structural differences between the BRICs and non-BRICs which have contributed to the growth disparity. Henceforth, it could be of interest for future scholars to improve on the results by exploring other growth determinants such as government consumption, inflation, taxation, black market premium, etc. Alternatively, the sample size and/or time period may be altered, different theories of

growth may be adopted such as endogenous or Schumpeterian complemented by estimation techniques including seemingly unrelated regression (SUR) and dynamic panel models to discern whether the limitations of our model choice has biased any of the findings.

Chapter 3

The Ins & Outs of Brazilian Unemployment in a four-tier Labour Market

Abstract

In this paper, we seek to elucidate the dynamics of the Brazilian labour market over the period 2002 to 2014. Using the new Monthly Employment Survey (PME-Nova), the size and cyclical patterns of the gross flows and transition rates are examined between different market states and thereafter results are compared with those reported for the Spain, UK and US. Finally, a 6-state model is introduced to compute the contribution of the different transition rates to unemployment volatility by considering the employment quadrility associated to labour markets in developing countries. Our findings suggest that the transition rates involving all types of employment are important in explaining the cyclical fluctuations in unemployment. However, those involving permanent contracts have a more prominent role compared to the transition rates related to temporary contracts. What's more, permanent contracts play a crucial role in job creation but even more so in job destruction. Hence, these transition rates seem to hold the key in understanding the cyclical flux in Brazilian unemployment rate.

3.1 Introduction

Do inflows or outflows influence unemployment dynamics? Since the 1980s, it has been up for debate where the initial focus was on the US labour market but in time shifted towards other developed economies. The US has always been good at recording rich data over extended periods and thus, in all likelihood seems to be the appropriate place of birth for the research. A look at the recent literature indicates that job finding rate dominates the fluctuation in the US unemployment rate but separation rate has no cyclical impact (Hall, 2006; Shimer, 2012). This was a key finding which in turn later inspired the development of labour market theories with a-cyclical separation rate (Blanchard & Gali, 2010). In contrast, Fujita & Ramey (2009) and Elsby et al. (2009) using Current Population Survey with gross flow and duration-based data respectively arrive to the conclusion that separation or inflow rate explains about half of the unemployment variance and leads cyclical changes in unemployment. However, Petrongolo & Pissarides (2008) and Smith (2011) looking at European countries finds that both ins and outs of unemployment are imperative in explaining a country's unemployment volatility where each rate may dominate depending on the state of the economy.

In this research, we shed some light on the dynamics of the Brazilian labour market by examining the transition rates in a 6-state set-up that takes into account employment quadrility, using the new Monthly Employment Survey (PME-Nova) from 2nd quarter of 2002 till 4th quarter of 2014. Our contribution to the literature comes in the following ways. First, we have analysed the dynamics of the unemployment volatility in Brazil using the flow data from PME-Nova. Understanding flows are important since they affect labour market indicators and fluctuations over the business cycle. Interestingly, this is one

of the few papers to have conducted a flow analysis considering employment quadrility present in developing countries. Second, in order to inspect the ins and outs of unemployment and more generally worker flows between different states, we have used data from PME-Nova that have been revised to be in line with the ILO recommendation for more accurate international comparability. This improvement provided us detailed information on types of employment contracts and thereby made it possible to carry out an in-depth analysis of the labour market in Brazil. Third, to observe the contribution of the transition rates to fluctuations in the aggregate unemployment rate, we have set-up a 6-state model to account for temporary and permanent jobs in both the formal and informal sector and therefore resembling the labour markets of developing countries.

Whilst the size and cyclical pattern of gross flows has often been studied for a growing list of developed countries (particularly, the US and European), there has only been a couple of studies such as Hoek (2007), Bosch & Maloney (2008) etc. that have focused on developing ones. We found that there are two main reasons for this understudy. First, a large collection of data is required at the micro-level to account for population characteristics in order to compute the correct flows of workers and jobs between various market states. However, the problem is these are either missing or when they are indeed recorded are often observed with errors. Second, the labour force survey is a meticulous task which is costly and time-consuming. Thus, with limited resource at disposal, the developing countries usually find it worthwhile to invest in other projects and not follow-up on the survey, making it almost impossible to track the worker flow patterns between market states. However, as Ball et al. (2011) explains if the issues hampering this body of literature can be overcome, there is scope for much to be explored.

Unlike other developing countries, Brazil has recorded micro-level data since the early 1980s and as such enabled researchers like Hoek (2007), Bosch et al. (2007), Bosch & Maloney (2008) and Bosch & Esteban-Pretel (2012) to evaluate the gross flows between formal and informal sector over the period 1983 to 2001. The focus was always on the rising informality which was as high as 70% of total employment towards the end of 1990s. Evidence from countries with large informal sector has shown that cyclical fluctuation in such labour markets are characterised by movements in unemployment which are not that different from those in developed countries. However, important reallocations take place over the business cycle between formal and informal market. Brazil's move towards informality was triggered by the trade liberalization along with rising labour cost and reduced flexibility brought forward by the Constitutional reform of 1988 which led to a drastic fall in the formal sector job finding rate. Our research is quite different from others to-date, in that we look at post-2001 Brazil which has experienced a rise in formality. Furthermore, with the new data at disposal, we have a unique opportunity to analyse the Brazilian labour market with greater precision and more importantly unearth the unemployment dynamics for this sudden rise in formality.

With that in mind, at first, we conduct a flow analysis of the Brazilian labour market focusing on the gross flows. Thereafter, we examine the transition rates in accordance to the most recent literature i.e. we study the dynamics of the labour market in a 6-state set-up (employment: formal temporary, formal permanent, informal temporary, informal permanent, unemployment and inactivity) explicitly considering employment quadrility. Second, we compare the transition rates with those found in Spain and more flexible labour markets such as the UK and US. Third, we evaluate the business cycle properties by looking at the co-movements between real GDP and the transition rates using the

unconditional cross-correlations. Finally, we represent the decomposition of the relative importance of the transition rates to equilibrium unemployment dynamics in the 6-state set-up to resemble developing labour markets and thereby further extend the methodologies introduced by Fujita & Ramey (2009), Shimer (2012) and Silva & Vazquez-Grenno (2013) for the 3-state and 4-state model respectively.

All our results point to a broadly similar conclusion i.e. the employment quadrility is crucial towards understanding the unemployment volatility particularly in developing countries and in our scenario the functioning of the Brazilian labour market. Specifically, we perceive that about 53% of the gross flows between employment and unemployment involve permanent contracts and it is more pronounced in the formal sector (55%). Temporary contracts make up the rest and enjoy the lion's share of employment in the informal sector (94%). Moreover, inactivity constitutes approximately 44% of the working-age population where ins and outs significantly outpace that of unemployment similar to the Japanese labour market (Lin & Miyamoto, 2012). This implies that the stock of inactive workers is an important source of labour supply for the economy and therefore crucial for explaining labour market activities in Brazil.

On the evolution in the ins and outs of unemployment, our study uncovers that decrease in the aggregate unemployment rate is largely due to increase in the number of workers being hired predominantly in the formal sector and an overall fall in the number of separations, consistent with the concept of increased formalization in the 21st century Brazil. With regards to the transition rates, counter-cyclical behaviour is detected generally from employment to unemployment and it is more pronounced in the share of temporary jobs which implies that the part-timers are often the first to be laid-off when

economy is not performing well. Although this outcome is true for the formal sector, spikes during the recessions indicate that workers suffer equally irrespective of the contract type in the informal sector. We perceive that movements in the transition rate from unemployment to employment and employment to unemployment roughly explains about 1% and 42% of all the fluctuations in the aggregate unemployment rate respectively, verifying that job separation rate plays a more dominant role in accounting for the country's unemployment rate volatility similar to findings from the US. Furthermore, more than 60% of the unemployment volatility are explained by movements between unemployment and employment involving transition rates to and from permanent jobs.

Last but not the least, note that the set of stylized facts established in our study are important for future researches. This may include those interested in the Brazilian labour market or simply in the international comparison with regards to the labour markets in other countries. Gomes (2012) highlights how the stylized facts are incredibly imperative to policymakers and macroeconomists alike. On one hand, they help policymakers to monitor business cycles, detect turning points and assess labour market tightness. On the other hand, they help macroeconomists to calibrate a number of parameters. Since worker flows and transition rates play an important role in the search and matching model of Mortensen & Pissarides (1994), our paper provides a guideline of the empirical features to researchers who use this framework.

The remainder of the study is structured as follows. In Section 3.2, we introduce the database, discuss the size of informality by sub-group and explain the adopted methodology. Section 3.3 presents our analysis of the transition rates and their

comparison with those from the Spain, UK and US. In Section 3.4 we delve with the business cycle properties of the transition rates. Section 3.5 considers decomposition of the unemployment volatility and finally, Section 3.6 concludes.

3.2.1 Data: PME-Nova

The data for the research is obtained from new Pesquisa Mensal de Emprego (PME-Nova) i.e. new Brazilian Monthly Employment Survey conducted by the Instituto Brasileiro de Geografiae Estatistica (IBGE). It is an in-depth monthly household interview on 6 of the country's major metropolitan regions (Belo Horizonte, Porto Alegre, Recife, Rio de Janiero, Salvador and Sao Paulo) consisting of 145 municipalities, 2029 sectors and 37212 households. Roughly, that covers about 25% of the national labour market. The questionnaire is typical in nature and records labour market activities and demographic changes for members of the household over the age of 10. Although PME is only representative of the urban labour market, it is best suited for our purpose since other surveys like the Pesquisa Nacional Por Amostra de Domicílios (PNAD) lack the panel structure that allows to study on worker flows.

PME is structured as a rotating panel, tracking each household across 4 consecutive months, dropping it for a sample of 8 months and then re-introducing it again for another 4 months. Each month 1/4 of the sample is substituted by other households to form a new panel. Thus, after 4 months the whole initial sample has been rotated, after 8 months a third different sample is being surveyed and after 12 months the initial sample is re-interviewed. Over a period of 2 years, 3 different panels of households are surveyed and the process resumes again with 3 new panels. Taking into account the structure of the database, we can then obtain the gross flows by computing the month-to-month transition made by individuals between different market states. In particular, we obtain the gross flows by implementing a 6-state model (employment: formal permanent, formal

temporary, informal permanent, informal temporary, unemployment and inactivity), explicitly taking into account employment quadrality.

Generally speaking, there is a broad consensus in the literature on what constitutes informality and studying transitions often raises some particular definitional complexities. We follow the International Labour Organization (ILO) definition in dividing the employed workforce into different states. In Brazil, every worker on entering the job market is issued with a work permit or "*carteira de trabalho*" as it is commonly known. Bosch & Maloney (2008) describes the formal workers as individuals who have a registered work permit and works in firms licensed with the government in compliance with tax and labour laws (including minimum wage directives, pension and health insurance benefits, workplace standard for safety etc.), granting them access to all forms of labour protection. On the other hand, employees whose contracts are not registered or owners of firms (predominantly micro) that are largely de-linked from the state institutions/obligations and as such individuals working in them are not covered by labour protection are considered to be informal. Payroll tax in Brazil exceeds 30% of a worker's wage, one of the highest in Latin America and therefore it induces many workers to work without registration as their take-home pay is higher (Hoek, 2007).

We can sub-categorize the formal workforce into 2 groups based on whether they are employed for a specified-term (as per legislation this duration cannot exceed 3 months) or indefinitely till the employer and employee wishes to separate. Typically, the main channel of recruitment in state-owned firms occur through the use of permanent contracts and henceforth these workers are referred to as formal permanent. On the contrary, temporary contracts are offered only when the situation arises for instance, to

substitute the regular worker in the case of maternity leave or to tackle the sudden surge in demand particularly during the holiday season. These individuals are quoted as formal temporary. According to Associação Comercial de São Paulo (ACSP), such contracts are highly popular with firms in retail business, offering around 70% of all fixed-term contracts. Once this contractual period comes to a closure, the employer evaluates whether to hire the worker on a permanent basis, extend the term of the temporary work (if the Ministry of Labour permits, this duration cannot exceed 6 months), employ informally or dismiss the worker altogether. Note that the relationship between the worker on a temporary contract and the firm that retains him is managed by a third party: an employment agency. Hence, the worker is not an employee of the company that needs the temporary help but instead an employee of the employment agency.

Alternatively, the informal workforce can be sub-classified into 2 groups based on their motivation and relative level of job satisfaction as per Perry et al. (2007a). One group consists of independent, self-employed or owner of micro firms who report of being as well-off as they would be in formal jobs. These are often middle-aged or older workers who choose their occupations according to their individual needs (i.e. desire for flexibility and autonomy) and abilities (i.e. comparative advantage in terms of entrepreneurship). As a result, such entrepreneurial group operates outside the regulatory system and voluntarily does not search for formal jobs. However, as Barth (2004) reports from a survey between 2000 and 2002 by the Serviço Brasileiro de Apoio às Micro e Pequenas Empresas (Sebrae), only 57% of these micro firms survive past the 3rd year of start-up due to weak management skills of the owners resulting in a shortage of working capital and other financial problems along with unsound and non-existence market knowledge. The situation is further aggravated by red tape which drastically cuts the lifespan of these

small businesses. Broadly speaking, since their duration of work is of an unspecified sort and closely resembles those with permanent contracts, we designate these workers as informal permanent.

In contrast, the other group is the informal salaried which encompass of domestic workers, micro firm employees and those who work in state-owned large firms under informal labour arrangements. These are individuals who lack the skills to get a formal job, capital to become self-employed or cannot accrue sufficient years to secure a meaningful pension. Given that their jobs are often in line with fixed-term contracts, we consider them as informal temporary. Interestingly, Perry et al. (2007b) proclaims that informal salaried jobs are often viewed as the point of entry into the labour market for many of the young workers where they are believed to hone their skills before venturing for formal jobs or realizing any desire to be self-employed.

Formal and informal jobs do not exist in independent spheres of the economy. In fact, as Hoek (2007) explains a typical lay-out within small firms is to have a core set of employees with formal contracts whilst those who are less essential are handled informally. The reason behind such arrangement is the substantially high overhead costs associated to employing individuals with formal contracts (usually around 70% of a worker's wage). Tokman (1992) argues that the regulatory authorities know well that most firms have difficulty in affording employees with a formal contract which is why they scrutinize less on following guidelines and checking books etc. when conducting their everyday business. Thus, smaller firms tend to have a larger share of workers with informal contracts. In contrast, almost all individuals in large state-owned firms, particularly in manufacturing are unionized and operate primarily with formal contracts.

In order to utilize our survey data and construct these aforementioned flows we stumbled upon 4 major issues. First, it is perceived that PME-Nova do not assign the same identification number to each individual in the household making it impossible to track them correctly across the survey. We fix this issue by using the Data Zoom package developed by the Department of Economics at PUC-Rio which offers identification algorithms based on Ribas & Soares (2008). Second, irrespective of the type of employment attrition makes it impossible to match all individual workers across months which may lead to the omission of possible transitions from the data. In PME-Nova, the unconditional non-responses vary between 11 to 17% of the sample. This issue is resolved utilizing the missing-at-random technique which drops the missing observations and re-weights the measured transitions, resulting in almost 18% of the survey to be eliminated. Third, despite our best efforts with the prior adjustment, missing information is observed with regards to the worker's sector of operation and in turn their contract type. We decipher this issue by reallocating these individuals, making it consistent with the degree of informality in Brazil.[1]

According to the Instituto de Pesquisa Econômica Aplicada (IPEA), a government-led research organization, informality within the metropolitan regions varied between 38 to 49% based on the National Household Survey (PNAD) since 2002 onwards. Following the aforesaid reallocation our data exhibits about 51% of the labour force to be informally employed. World Bank (2002) argues that the existence of substantial lay-off costs in termination of formal contracts is one of the main grounds behind firms in Brazil employing informal workers. Furthermore, Filho & Scorzafave (2009) while looking at

[1] A more detailed discussion on tracking worker transitions and assigning missing contracts are at the end of Appendix B as "additional notes".

informality in terms of education, race, gender and age-group uncovers that in Brazil around 91% of all part-timers are informal, 60% are young individuals and the majority share are women. Hence, based on all the facts, it seems logical to make the allocation as such.

The final issue is associated to the point-in-time measurement of worker status which fails to record transitions within the period, commonly known as time aggregation bias. For instance, if a worker is employed in the 1st week of the month, loses his job in the 2nd and then is re-employed by the 3rd, our monthly survey data will not perceive any of those transitions. Nevertheless, the bias arising from these multiple transitions within the period can be surmount by computing the weekly transition rates from the observed monthly rates. Section 3.3.1 will explain the procedure in greater detail. It is worth noting that as per the recommendations from ILO, in 2002, PME-Antiga concepts and methodology underwent drastic modification to take account of changes in the work place and enable more accurate international comparability. For instance, under the old methodology, IBGE considered working-age population to be those over the age of 15 compared to the new methodology where the age limit is raised to 18. This meant that the new and old definitions of unemployment are no longer reconcilable. Hence, our time span for the research is from 2nd quarter of 2002 (starting quarter of the new micro-data series) till 4th quarter of 2014.

3.2.2 Size of informality

Given that over 50% of the labour force in Brazil is informally employed, it may be of interest to look at how the labour market is characterised by the different sub-groups of workers based on gender, age and education. Table B1 of Appendix B encapsulates the average stock of the different sub-groups of individuals in the informal sector.

First, we analyse the gender distribution of workers. Clark et al. (1991) argue that in the 1980s female participation has been substantially low in the Latin American countries compared to their counterparts elsewhere, largely due to the traditional exclusion of females from paid agricultural jobs and the ideological support for male dominance. However, this outlook drastically changed and over the next few decades more and more females have entered the labour market. In a recent survey, it has been estimated that as much as 33 million females from the Latin American urban areas have joined the labour force between 1990 and 2004, constituting about 40% of the economically active population (Abramo & Valenzuela, 2005). With regards to Brazil, we perceive that the informal sector employs male and female individuals quite equally i.e. 14.04% and 12.27% of the working-age population respectively.

Second, we evaluate the age-profile of workers. In the literature, the common consensus is that the labour market mostly comprises of prime-aged workers (or individuals aged between 24 and 49 years), followed by older workers (or individuals aged over 50 years) and young workers (or individuals aged under 24 years) respectively. In Brazil, a similar pattern is observed with the informal sector primarily employing prime-aged workers i.e. 15.39% of the working-age population, followed by older and young workers i.e. 6.86% and 4.06% of the working-age population respectively. It is worth noting that in order to

tackle the numerous social issues prevalent in developing countries, Brazil has undertaken steps in the form of establishing several welfare programs such as *Bolsa Família* and *PETI* in the early 2000, specifically aimed at alleviating poverty, eliminating child labour and developing better human capital.

Finally, we focus on the education level of workers. It is found that the informal sector employs predominantly individuals with primary level of education i.e. 10.35% of the working-age population, followed by secondary level of education i.e. 7.77% of the working-age population and the least with tertiary level of education i.e. 4.81% of the working-age population. This is consistent with the fact that highly qualified workers are more suited for formal sector jobs since they have the ability to work in challenging environments that rewards handsomely for knowledge gained through training in the prior years. Ghose et al. (2008) supports the notion emphasizing that the more educated individuals become, the more they will value their investment in skill development which is why they are willing to dedicate more time and resource to search for appropriate formal sector jobs than just accepting employment informally.

3.2.3 Average gross flows

Figure B1 of Appendix B summarizes the monthly average gross flows between the 6 market states namely, formal permanent employment, formal temporary employment, informal permanent employment, informal temporary employment, unemployment and inactivity over the period 2002 to 2014. It reports the stock of workers in each state in thousands (t) and as a percentage of the working-age population (p) as well as the number of individuals that change status every month as a percentage of the working-age population (p) and as a transition probability or hazard rate (h). We perceive that the formal sector employs 23.42% of the working-age population with permanent contracts and 1.73% of the working-age population with temporary contracts whilst the informal sector employs more equally i.e. 12.25% of the working-age population with permanent contracts and 14.06% of the working-age population with temporary contracts, representing 45%, 3%, 24% and 27% of total employment respectively.

Over the period of survey, net employment increases by an average of 110 per month which delineates 0.16% of the working-age population. Fundamental to this net increase in total employment are the various flows that help explain the key features of the Brazilian labour market. Interestingly, it is observed that approximately 53% of the worker flows between employment and unemployment involve a permanent contract and it goes up to 58% between employment and inactivity. Bosch et al. (2007) argue that whilst trade liberalization and strengthening of the labour rights under the Constitution of 1988 played crucial roles for the rise in informality; loosening of the labour market regulations in 2000 are responsible for the increase in formalization. This is evident from the data as well which indicates that net employment in the formal sector increases by an average of

90 per month (0.12% of the working-age population) compared to the informal sector where the average is about 20 per month (0.04% of the working-age population).

As we further disaggregate the worker flows based on whether they are employed temporarily or on a permanent basis in the formal or informal sector, more interesting facts begin to surface. In the formal sector, every month on average 0.18% of the working-age population move from unemployment to permanent jobs and 0.15% moves in the opposite direction. In contrast, the flows between unemployment and temporary jobs are much smaller with an average of 0.01% and 0.07% of the working-age population respectively moving each month to and from unemployment. Alternatively, in the informal sector, every month on average 0.15% of the working-age population move from unemployment to permanent jobs and 0.12% moves in the reverse. In contrast, the flows between unemployment and temporary jobs are considerably larger with an average of 0.21% and 0.28% of the working-age population respectively moving each month to and from unemployment.

What's more, there are a significant number of workers moving between the formal-informal sector and employment contracts. First, if only the flows between employment contracts are considered, it is observed that on average 0.15% of the working-age population move per month in the formal sector from temporary to permanent jobs whilst the flows in the opposite direction reach 0.14%. In contrast, the flows in the informal sector are much larger with an average of 0.61% of the working-age population moving from temporary to permanent jobs and 0.63% moving in the other direction. Second, allowing only for the flows between the sectors, it is found that on average 0.29% of the working-age population move per month from informal permanent to formal

permanent jobs whilst the flows in the reverse direction reach 0.27%. In contrast, about half of these Brazilian workers move between temporary jobs i.e. on average 0.15% of the working-age population moves from informal temporary to formal temporary jobs whilst 0.14% moves the other way around. Third, taking into account the cross flows, it is noticed that on average 0.98% of the working-age population move per month from informal temporary to formal permanent jobs whilst the flows in the opposite direction reach 0.87%. In contrast, an average of just 0.01% of the working-age population moves to and from informal permanent to formal temporary jobs.

Henceforth, the relative magnitude of these transitions from unemployment to the different types of employment and between their respective states gives an idea of how the Brazilian labour market creates employment. Remarkably, it also highlights the country's unusually high turnover rate. According to a government study in 2013, the Secretariat for Strategic Affairs found that about 40% of the Brazilians leave workforce within a given year which goes up to 80% for low paying jobs. Gonzaga et al. (2003) emphasizes on how this has deeply scarred on-the-job-training which in turn has hampered building of specific human capital and thereby labour productivity. It is identified that most individuals leave jobs largely due to no perception of professional growth (31%), challenging hierarchical relations (26%), lack of incentives and benefits (17%), insufficient alternatives that promote a balance between personal and professional life (15%), contract non-compliance (5%), working over-time (5%) or plans of establishing own business (1%). Whilst a month's advance notice is compulsory by law for employers before firing, there is usually no binding clause for an employee who can turn up and resign. The root of this mentality is proposed to be cultural where working is considered as an obligation rather than an enterprise.

Note that our findings so far highlight 2 important features of the Brazilian labour market. Whilst substantial movements are observed to and from permanent contracts in the formal sector, there are considerable movements to and from permanent as well as temporary contracts in the informal sector. Bourguignon & Dethier (2005) argue that young adults, particularly those who are educated and financially better-off either wait-out or chop-and-change till their preferable permanent jobs become available. This later approach is perhaps due to the high level of mismatch often observed among young workers which generate the incentive to move between jobs according to their skill-sets and therefore accounts for the chunk of movement in the formal sector.

Since the early 2000s, Brazil observed a rise in the minimum wage which nearly doubled in real terms in an attempt to eradicate poverty and improve living standard. According to DIEESE (Inter-Union Department of Statistics and Socio-Economic Studies), it has increased from a mere R$266 in February of 2000 to as high as R$510 in January 2010. Neri & Moura (2006) imply that this has led to a significant rise in the labour cost as close to 15% of the formal labour force earns the minimum wage. On top of that, it determines the salaries of other workers on the pay scale as it is often used as the *numéraire*, with worker salaries set as multiples of the minimum wage. In Brazil, firms by law must pay compensation equivalent to 40% of all the obligatory savings accumulated on the job from the Severance Indemnity Fund, known as FGTS for unjust dismissal. Thus, Filho & Scorzafave (2009) accentuate that the system perversely motivates formal sector workers to often change jobs, whilst also discourage firms to keep the same workforce for long.

On the other hand, Brazil is a developing country where majority of the population is relatively poor. Once individuals reach the working-age, they mostly accept any

occupation on offer which may be informal, low-paid and perilous to support their family's livelihood. The youths from inferior backgrounds are usually employed on a temporary basis and involve in domestic work such as cleaning, cooking, fruiting picking etc. IPEA (2006) and Ernst (2008) highlight that whilst the increased flexibility of the labour market coupled with cultural and socio-economic reforms has led to an influx in female participation; to a large extent they still continued to work in low productivity and informal fixed-term jobs even when they are more educated than their male counterparts. Since these causal workers including those who are self-employed frequently enter and exit the labour market, they are presumed to be responsible for the chunk of movement in the informal sector.

Last but not the least, we focus on inactivity in an attempt to unravel its relationship with the various employment states and unemployment. Considering the size and its corresponding flows, it seems to play a crucial role in understanding labour market activity. Based on our sample, inactivity represents about 44% of the working-age population.[2] However, it appears to be a feature of the Brazilian labour market as Hoek (2007) documents similar findings when analysing the average gross flows over the period 1982 to 1998 using data from PME-Antiga (i.e. old PME), reporting it close to 48% of the working-age population. We also uncover that the flows in and out of inactivity are substantially large compared to the flows in and out of unemployment, which insinuates that the stock of inactive workers are an important source of labour supply for the economy. Interestingly, such labour market behaviour is not restricted to only developing

[2] According to the ILO, an individual is classified as unemployed if he is not working, currently available for work and actively looked for a job within a specific reference period. However, as Aguas et al. (2014) argues problem arises if for instance, the individual has actively looked for a job prior to the reference period or passively looked for a job such as one in the newspaper ads. Since neither meet the above set criteria, the individual will be reported as inactive which in turn underestimates the unemployed pool. Hence, it is often referred to as "hidden" unemployment.

countries. Lin & Miyamoto (2012) surveying the Japanese labour market argue that inactivity constitutes 37% of the working-age population (which rose to 40% in recent times) where flows in and out of inactivity significantly outpace that of unemployment.

We presume that these considerably large flows in and out of inactivity are possibly attributable to the various welfare programs established by the Brazilian government in the early 2000s to address numerous social issues and enhance human capital development. These are cash transfer schemes and those below the threshold per capita income (R$50 per month as in 2004 at its inception) have to meet certain conditions to be eligible. For instance, families with children between the ages of 6 and 17 have to attend school and timely vaccinated, pregnant women have to perform all prenatal and postnatal check-ups, etc. Hoffmann (2006) and Barros et al. (2007) argue that the level of coverage in these programs have played a key role in reducing inequality, noticeable from the Gini coefficient which fell by 87% between 2002 and 2004 for the poorest regions, like the Northwest. According to the OECD Economic Survey (2015) rising income in Brazil coupled with improved access to health and education are perchance liable for flux in the labour force participation.

As we observe in the formal sector, every month on average 0.38% of the working-age population move from inactivity to permanent jobs and 0.44% moves in the opposite direction. In contrast, the flows between inactivity and temporary jobs are significantly smaller with an average of just 0.05% of the working-age population moving to and from inactivity. Alternatively, in the informal sector, every month on average 0.66% of the working-age population move from inactivity to permanent jobs and 0.63% moves in the opposite direction. In contrast, the flows between inactivity and temporary jobs are

notably larger with an average of 0.74% of the working-age population moving from inactivity to temporary jobs and 0.69% moving in the reverse direction. Lastly, we spot that the movement from inactivity to unemployment and vice versa are 1.14% and 1.09% of the working-age population respectively.

3.3.1 Methodology

There are two main approaches to evaluate the labour market dynamics, particularly, the flows amid different market states. Authors like Abowd & Zellner (1985), Blanchard et al. (1990) and Davis et al. (2006) focus on analysing the gross flows whilst others such as Hall (2006), Elsby et al. (2009), Fujita & Ramey (2009), Smith (2011), Shimer (2012) and Silva & Vazquez-Grenno (2013) emphasize more on the transition rates. The two standpoints are complementary in their investigation of the labour market where the choice of approach eventually depends on the theoretical model one has in mind. In our study, we adopt the most recent approach and concentrate on the transition rates.

The fundamental notations that illustrate the dynamics of the Brazilian labour market are as follows. Along with the states of unemployment (U) and inactivity (I), we unequivocally consider the 4-tier structure of Brazil's labour market in these equations. There are 4 types of contract that delineate this quadrility: formal temporary (FT), formal permanent (FP), informal temporary (IT) and informal permanent (IP). As a result, the dynamics of this 6-state model as a function of the transition rates (Λ_t^{X-Y}) evolve according to the following differenced equations.

$$U_t - U_{t-1} = -(\Lambda_t^{U-FP} + \Lambda_t^{U-FT} + \Lambda_t^{U-I} + \Lambda_t^{U-IP} + \Lambda_t^{U-IT})U_{t-1} + \Lambda_t^{FP-U}FP_{t-1} + \Lambda_t^{FT-U}FT_{t-1} + \Lambda_t^{I-U}I_{t-1} + \Lambda_t^{IP-U}IP_{t-1} + \Lambda_t^{IT-U}IT_{t-1} \quad (1)$$

$$FP_t - FP_{t-1} = -(\Lambda_t^{FP-FT} + \Lambda_t^{FP-U} + \Lambda_t^{FP-I} + \Lambda_t^{FP-IP} + \Lambda_t^{FP-IT})FP_{t-1} + \Lambda_t^{FT-FP}FT_{t-1} + \Lambda_t^{U-FP}U_{t-1} + \Lambda_t^{I-FP}I_{t-1} + \Lambda_t^{IP-FP}IP_{t-1} + \Lambda_t^{IT-FP}IT_{t-1} \quad (2)$$

$$FT_t - FT_{t-1} = -(\Lambda_t^{FT-FP} + \Lambda_t^{FT-U} + \Lambda_t^{FT-I} + \Lambda_t^{FT-IP} + \Lambda_t^{FT-IT})FT_{t-1} + \Lambda_t^{FP-FT}FP_{t-1} + \Lambda_t^{U-FT}U_{t-1} + \Lambda_t^{I-FT}I_{t-1} + \Lambda_t^{IP-FT}IP_{t-1} + \Lambda_t^{IT-FT}IT_{t-1} \quad (3)$$

$$IP_t - IP_{t-1} = -(\Lambda_t^{IP-FP} + \Lambda_t^{IP-FT} + \Lambda_t^{IP-U} + \Lambda_t^{IP-I} + \Lambda_t^{IP-IT})IP_{t-1} + \Lambda_t^{FP-IP}FP_{t-1} + \Lambda_t^{FT-IP}FT_{t-1} + \Lambda_t^{U-IP}U_{t-1} + \Lambda_t^{I-IP}I_{t-1} + \Lambda_t^{IT-IP}IT_{t-1} \quad (4)$$

$$IT_t - IT_{t-1} = -(\Lambda_t^{IT-FP} + \Lambda_t^{IT-FT} + \Lambda_t^{IT-U} + \Lambda_t^{IT-U} + \Lambda_t^{IT-IP})IT_{t-1} + \Lambda_t^{FP-IT}FP_{t-1} + \Lambda_t^{FT-IT}FT_{t-1} + \Lambda_t^{U-IT}U_{t-1} + \Lambda_t^{I-IT}I_{t-1} + \Lambda_t^{IP-IT}IP_{t-1} \quad (5)$$

$$I_t - I_{t-1} = -(\Lambda_t^{I-FP} + \Lambda_t^{I-FT} + \Lambda_t^{I-U} + \Lambda_t^{I-IP} + \Lambda_t^{I-IT})I_{t-1} + \Lambda_t^{FP-I}FP_{t-1} + \Lambda_t^{FT-I}FT_{t-1} + \Lambda_t^{U-I}U_{t-1} + \Lambda_t^{IP-I}IP_{t-1} + \Lambda_t^{IT-I}IT_{t-1} \quad (6)$$

where Λ_t^{X-Y} represents the transition rate from state X in period $t-1$ to state Y in period t. These transition rates (between period $t-1$ and t) are computed as a fraction of the flows from state X to state Y and the number of individuals in state X at period $t-1$. For instance, the transition rate between unemployment and formal permanent employment Λ_t^{U-FP} is computed as N_t^{U-FP}/U_{t-1}, where N_t^{U-FP} is the number of individuals moving from unemployment to formal permanent employment between period $t-1$ and t.[3] All these transition rates are then seasonally adjusted using the Census Bureau's X-13 program to reveal the non-seasonal features that was previously masked by the seasonal influence.

Finally, as discussed in Section 3.2.1, these transition rates may represent time aggregation bias since they fail to capture the presence of multiple transitions within a given period. This issue is resolved by re-computing the monthly transition rates implied by the weekly rates in our 6-state model. To be exact, we apply the Markov-Chain transition matrix to compute the weekly (w) transition rates from the seasonally adjusted monthly (m) transition rates and the system of equations characterized by equation (7) below.

[3] Where X and $Y \in \{U, FP, FT, IP, IT, I\}$.

$$\Lambda_{m,t}^{ij} = \sum_{k}\sum_{l}\sum_{n} \Lambda_{w,t}^{ik}\Lambda_{w,t}^{kl}\Lambda_{w,t}^{ln}\Lambda_{w,t}^{nj}, \quad i,j,k,l,n \in \{U, FP, FT, IP, IT, I\} \tag{7}$$

Although this may cause upward bias in the transition rates, we are assuming that an individual's labour market status doesn't change within a given week which is consistent with the ILO definition. Once the weekly transition rates are worked out, we simply multiply them by 4 (i.e. 4 weeks in a month) to obtain the corrected seasonally adjusted monthly transition rates.

3.3.2 Worker transition in the labour market

With the model set-up, we investigate the dynamics of the Brazilian labour market with the help of transition rates focusing on their behaviour over the economic crises in the post-2000 period.

Figure B2 of Appendix B illustrates the evolution of the key labour market indicators over the course of study. Based on the data, the employment rate (top left panel) has a distinct upward trend, averaging around 51%, peaking at 55% by the end of 2012, slowing down over the downturns and significantly dipping during the Global recession lasting 2 quarters till March 2009. On the other hand, the unemployment rate (top right panel) has a visible downward trend, averaging around 8%, substantially rising in recessions, peaking around 13% by 2003 and early 2004 and gradually falling to a low 4%. Although behaviour of the inactivity rate (bottom left panel) and the participation rate (bottom right panel) remains random, it is observable for both only after 2003. Interestingly, the *Bolsa Família* which encompassed all other existing social programs (*Bolsa Escola, Bolsa Alimentação, Auxílio Gás and Cartão Alimentação*) came into full effect in 2004 and therefore as discussed in Section 3.2.2 is believed to be a contributing factor behind the erratic changes in labour market flows. Furthermore, whilst the former has risen during the downturns and more profoundly in the Global recession, the later has fallen concurrently.

Figure B3 of Appendix B portrays the evolution of the share of contracts over the period of study. Looking at the whole economy, there appears to be a move towards formalization (top left panel). This is consistent with Berg (2011) who argues that the increased demand for formal workers, improved labour inspection, Simples law (a new system of tax exemption and simplification for small and micro enterprises) and greater

legal awareness among domestic workforce led to the rise in formal sector employment. What's more, permanent contracts have a more prominent role for employment (top right panel) and its importance has grown over time, particularly since the Global recession of 2008-09. Thus, the initial share of 66:34 between permanent and temporary jobs respectively changed to 75:25 as of late. The formal sector (bottom left panel) is clearly dominated by permanent contracts with an average share of 45% of total employment, whilst temporary contracts enjoy a slightly larger share i.e. an average of 27% of total employment in the informal sector. However, it has been falling over time and outpaced by permanent contracts in the last quarter of 2013. Lastly, over the downturns and recessions pro-cyclical behaviour are more pronounced in the share of temporary jobs which seem to suggest that these workers are often the first to be laid-off.

Since these large aggregate changes occur due to the transitions between different labour market states, at this juncture we will try to comprehend them in more detail. As expected, significant differences are observed between transition rates that involve permanent contracts and those involving temporary. Figure B4 of Appendix B demonstrates the dynamics of transition rates to and from unemployment and employment over the course of study. It is apparent that the scale of movement is much greater from temporary employment to unemployment than in the case of permanent employment (top left panel) in the formal sector. This explains the rising unemployment rate in 2003 and may be interpreted as a possible net increase in separation rate. Also, the substantial spikes throughout validate the earlier point that part-timers usually fall in the line of fire when the economy is not performing well.

A similar pattern is observed for the transition rates from employment to unemployment (top right panel) in the informal sector but with slightly elevated percentages. These transition rates from temporary and permanent jobs to unemployment seem to follow a downward trend indicating that less and less individuals remained with informal jobs as time progressed. When observing the behaviour of the transition rate from unemployment to employment, it is noticed that in the formal sector permanent jobs (bottom left panel) significantly dominates the movement of workers whereas in the informal sector temporary jobs (bottom right panel) play the more prominent role. Although the transition rates overall remain stable, the gradual upward trend in the transition rate from unemployment to formal permanent employment explains the country's rising employment rate which may also be described as a possible net increase in job finding rate. Lastly, separation rates in general have more volatile dynamics than job finding rates as is reported by Mortensen & Pissarides (1994) in their matching model of unemployment.

Figure B5 of Appendix B exhibits the dynamics of transition rates to and from inactivity and employment over the period of study. All transition rates follow a similar pattern particularly over the recessionary phases to the transition rates to and from unemployment and employment. However, there are some obvious differences. First, no distinct trends are observed in the transition rates from employment to inactivity involving temporary and permanent contracts either in the formal or informal sector. Second, the magnitude of these transition rates to inactivity are almost twice as large compared to movements from employment and unemployment which may help explain the country's falling unemployment rate and erratic participation rate. Third, whilst the fluctuations in the transition rates to inactivity are similar and overlap each other in the

informal sector (top right panel), only temporary jobs appear to be volatile in the formal sector (top left panel). Finally, regarding the transition rates from inactivity to employment, we observe that permanent jobs (bottom left panel) are visibly more influential in the formal sector whilst temporary jobs (bottom right panel) closely prevail in the informal sector. However, the latter's dominance is on the decline and eventually surpassed by permanent contracts in the late 2013.

Based on the results above on the evolution in the ins and outs of unemployment, it would seem that the decrease in the aggregate unemployment may be explained by an increase in the number of workers being hired particularly in the formal sector and an overall fall in the number of separations. However, once these individuals lose or leave their respective jobs, they tend to exit the labour market either directly or indirectly (i.e. through unemployment) to re-enter at a later date. During the periods of economic crisis, the behaviour of labour market is as expected and the observed rise in the aggregate unemployment may be interpreted as an overall increase in the number of workers losing jobs particularly those with part-time contracts and a fall in the number of hiring.

Having computed the figures for Brazil, it is now of interest to compare these with the empirical evidence from other countries. Table B2 of Appendix B displays the Brazilian monthly transition rates with the ones from Spain, the UK and US. Note that Bayes' Theorem has been applied to work out the aggregate transition values (for instance, from employment to unemployment etc.) from the disaggregate ones (for instance, from formal permanent employment to unemployment, from informal temporary employment to unemployment etc.). As expected, most of the transition rates are larger in labour markets with higher levels of overall flexibility. Specifically, the transition rate from

unemployment to employment for Brazil (5.09%) is similar to that from Spain (4.83%) but much smaller than those from the UK (9.98%) and US (49.83%). This suggests that it takes considerably longer for the unemployed Brazilians to find new jobs when compared to those in more developed countries. What's more, the transition rate is driven by all types of contract but with varying degrees of influence such as from unemployment to informal temporary (7.22%), formal permanent (5.00%), informal permanent (3.46%) and formal temporary (0.43%) respectively.

In terms of the transition rate from employment to unemployment, Brazil's (1.14%) is larger than both Spain's (0.73%) and the UK's (0.63%) but smaller than that of the US's (3.16%). This highlights Brazil's soaring turnover rate which as explained in Section 3.2.2 has much to do with the country's social beliefs and to some extent the strictly set labour laws. Hence, we perceive larger transition rates from employment to unemployment involving temporary and permanent contracts in the informal sector (1.81% and 1.14% respectively) compared to the formal sector (0.91% and 0.76% respectively). Notice that employment to unemployment transition rate for Brazil is almost 3 times smaller than that for the US (1.14% vs. 3.16%) whilst the opposite is nearly 10 times smaller in the former (5.09% vs. 49.83%). Although there are disparities, the transition rates so far and in what follows indicate that the Brazilian labour market operates as a mix of the European and the US labour market. Moreover, the large differences between unemployment entry and exit rates among the countries may be explained by other labour market institutions such as unemployment insurance, employment protection etc.

Proof of similarity with the US labour market is found when looking at the transition rates between unemployment and inactivity. Compared to Spain's (3.01%) and the UK's

(6.92%), Brazil's transition rate from unemployment to inactivity (28.80%) is significantly larger and despite being almost half is more in line with the US's (46.38%). This result combined with the fact that the transition rate from unemployment to employment is quite large explains how the unemployment rate in Brazil have fallen from a high 13% in 2003 to a mere 4% by the end of 2014. However, the transition rates from inactivity to unemployment are much smaller but both the US and Brazil display greater magnitudes (6.29% and 3.16% respectively) compared to the European counterparts (1.95% for the UK and 0.58% for Spain).

With regards to the transition rates from employment to inactivity, Brazil (3.61%) is identical to that of the US (3.31%) but they are both larger than Spain (0.67%) and the UK (0.61%). We notice that the transition rates are far more dominated by temporary and permanent contracts in the informal sector (5.17% and 5.37% respectively) compared to the formal sector (2.88% and 1.81% respectively), alike to the transition rates from employment to unemployment. In general, these notable exit rates from informal contracts may be the result of the various welfare programs established in the early 2000 to not only tackle the social issues such as child labour, poverty, etc. but also to enhance human capital development along with improved labour inspection as reported by Berg (2011). Conversely, the transition rate from inactivity to employment is the smallest for Brazil (1.22%), excluding Spain (0.67%), where most of the contributions come from inactivity to informal temporary (1.76%), informal permanent (1.56%) and formal permanent (0.79%) respectively.

Next, we priorities on the job-to-job transition rates for Brazil with regards to temporary and permanent contracts across the economy. Unfortunately, comparison is limited to

formal jobs as in the case for Spain and none for the UK or US. We perceive that the transition rate from formal permanent to formal temporary is somewhat similar for Brazil and Spain (0.65% vs. 0.49%). However, the transition rate for Brazil in reverse is more than 4 times larger when compared to that of Spain (9.35% vs. 2.16%). Focusing solely on Brazil, the most important job-to-job transition rates seem to be those involving formal permanent contracts from the available employment types (9.35% from formal temporary, 7.78% from informal temporary and 2.38% from informal permanent respectively). This shows the increased demand for formal sector workers as indicated by Berg (2011). Other notable job-to-job transition rates mostly revolve around informal contracts (9.26% from formal temporary to informal temporary; 5.78% from informal permanent to informal temporary; 4.91% from informal temporary to informal permanent; 4.15% from formal permanent to informal temporary respectively). As Kucera & Roncolato (2008) proclaims these are often fraction of independent workers who choose their occupations according to individual needs because of their desire for flexibility and autonomy. Hence, they are not compelled to but voluntarily prefer working in the informal sector.

Finally, we observe that the least job-to-job transition rates are those from formal permanent contracts to formal temporary (0.65%), from formal temporary contracts to informal permanent (0.55%) and from informal permanent contracts to formal temporary (0.08%) respectively. Note that these comparisons are affected by the differences in the range of age appraised. Gomes (2012) in his research on the UK labour market considered age groups of 16-65 years for males and 16-62 for females whereas Silva & Vazquez-Grenno (2013) in their evaluation of the Spanish labour market accounts for people older

than 16 years. The differences could be predominantly important for transition rates dealing with inactivity.

3.4 Business cycle properties

We analyse the properties of these transition rates at business cycle frequencies by computing the unconditional cross-correlations with output at 4 leads and lags. Table B3 of Appendix B outlines the cyclical correlation of the transition probabilities between the different forms of employment, unemployment and inactivity with the log of real GDP at leads and lags of up to a year. Since the data on real GDP is available on a quarterly basis, we have applied the same technique as discussed in Section 3.3.1 to obtain the weekly transition rates which are then multiplied by 12 (i.e. 4 weeks in a month and 3 months in quarter) to construct the corrected seasonally adjusted quarterly transition rates for this purpose. Finally, the cyclical component of the series is extracted using the Hodrick-Prescott (HP) filter with a standard smoothing parameter of 1600 for quarterly data. Therefore, when referring to variable x, we essentially denote to its cyclical component as conferred.

Our results depict that real GDP trails the cyclical behaviour in most of the transition rates, provided that their correlations reach maximum (in absolute values) at leads. This implies that the Brazilian labour market generally spearheads the business cycle. First, focusing on the formal sector, it is observed that the correlation between the transition rate from unemployment to temporary jobs (Λ^{U-FT}) and real GDP peaks at 0.440 simultaneously whilst the correlation between the transition rate from temporary jobs to unemployment (Λ^{FT-U}) and real GDP peaks at -0.328 at a lead of 4 quarters. These highlight to the pro-cyclicality of Λ^{U-FT} and the counter-cyclicality of Λ^{FT-U}. On the other hand, a pro-cyclical behaviour is found between the transition rate from unemployment to permanent jobs (Λ^{U-FP}) and real GDP with a maximum of 0.601 simultaneously.

However, the correlation coefficient between the transition rate from permanent jobs to unemployment (Λ^{FP-U}) and real GDP is not statistically significant.

Second, putting the spotlight on the informal sector, it is observed that the correlation between the transition rate from unemployment to permanent jobs (Λ^{U-IP}) and real GDP peaks at -0.325 whilst the correlation between the transition rate from permanent jobs to unemployment (Λ^{IP-U}) and real GDP peaks at -0.322, both simultaneously. These suggest to the counter-cyclicality of Λ^{U-IP} and Λ^{IP-U}. As for the correlation between the transition rate from temporary jobs to unemployment (Λ^{IT-U}) and real GDP, a counter-cyclical behaviour is also perceived with a maximum of -0.356 simultaneously. However, the correlation coefficient between the transition rate from unemployment to permanent jobs (Λ^{U-IT}) and real GDP is not statistically significant.

Third, there are mixed findings concerning the correlation coefficients between real GDP and the transition rates related to inactivity. The noteworthy ones' include the correlation between real GDP and the transition rates from inactivity to unemployment (Λ^{I-U}) which peaks at -0.441 simultaneously; from inactivity to formal permanent jobs (Λ^{I-FP}) which peaks at -0.425 at a lag of 3 quarters; from unemployment to inactivity (Λ^{U-I}) which peaks at -0.367 at a lag of 3 quarters; from formal permanent to inactivity (Λ^{FP-I}) which peaks at -0.344 at a lag of 4 quarters; from formal temporary to inactivity (Λ^{FT-I}) which peaks at 0.407 at a lead of 2 quarters and last but not the least, from informal temporary jobs to inactivity (Λ^{IT-I}) which peaks at 0.287 at a lag of 2 quarters. These indicate to the pro-cyclicality of Λ^{FT-I} and Λ^{IT-I} and the counter-cyclicality of Λ^{I-U}, Λ^{I-FP}, Λ^{U-I} and Λ^{FP-I}. All other correlation coefficients are not statistically significant, portraying a-cyclicality in their respective behaviour.

Finally, emphasizing on the correlation coefficients associated to the job-to-job transition rates, few are found to be statistically significant. For instance, a pro-cyclical behaviour is observed between real GDP and the transition rate from formal temporary jobs to formal permanent (Λ^{FT-FP}) where the correlation peaks at 0.433 at a lead of 2 quarters, from informal temporary jobs to formal permanent (Λ^{IT-FP}) where the correlation peaks at 0.405 at a lead of 2 quarters, from informal permanent jobs to formal permanent (Λ^{IP-FP}) where the correlation peaks at 0.308 at a lead of 1 quarter and from formal temporary jobs to informal permanent (Λ^{FT-IP}) where the correlation peaks at 0.363 at a lead of 3 quarters whilst only counter-cyclical behaviour is witnessed between real GDP and the transition rate from informal temporary jobs to formal temporary (Λ^{IP-FT}) where the correlation peaks at -0.364 at a lag of 1 quarter. This supports the argument that over the business cycle there are important reallocations between formal and informal jobs as put forward by Bosch & Esteban-Pretel (2012).

Note that our findings appear to be quite intuitive. In boom, there are increased economic activities so firms look to employ more workers which in turn boosts job finding rate and dampens separation rate. As a result, individuals move out of unemployment to various types of formal job (Λ^{U-FP} and Λ^{U-FT}). Moreover, the pro-cyclicality in job-to-job transition rates to formal permanent jobs (Λ^{FT-FP}, Λ^{IP-FP} and Λ^{IT-FP}) imply that during expansion firms not only welcome newcomers but also retain existing workforce via contract conversion. Likewise, good times generate the incentive for individuals to leave temporary jobs in search for a more productive and permanent match. Thereby, we observe pro-cyclicality in the job-to-job transition rates from formal temporary job to informal permanent (Λ^{FT-IP}) as well as from formal and informal temporary job to inactivity (Λ^{FT-I} and Λ^{IT-I}). This enables the fraction of workers who desire flexibility

and autonomy to become self-employed or go one-step further and become entrepreneur of their own micro firms.

Contrariwise, we anticipate the opposite happens in recession. As the economic activities decline, separation rate takes over and firms try to retrench by laying-off the extra workforce. Thus, we observe individuals moving back to unemployment irrespective of the type of incumbent job (Λ^{FT-U}, Λ^{IP-U} and Λ^{IT-U}). Although formal permanent job appears to be least affected, counter-cyclicality in the transition rate to inactivity (Λ^{FP-I}) suggests that on becoming redundant, these workers exit the labour market altogether. Similarly, counter-cyclicality is observed in the transition rate from unemployment to inactivity (Λ^{U-I}) and vice versa (Λ^{I-U}). The former may be described as 'discouraged workers' who exit the labour market as shrinking economy means fewer jobs are available to match their limited skill-sets or line of work whilst the latter may simply be workers coming out of inactivity to join the unemployment pool[4]. With formal jobs becoming scarce, individuals shift towards informality with counter-cyclicality being observed, particularly, in the transition rate from unemployment to informal permanent jobs (Λ^{U-IP}). This is consistent with the findings of Bosch et al. (2007) who draws similar conclusion for the US and Mexico.

[4] Lundberg (1985) proclaims that these workers often include married women who facing credit constraint temporarily enter the job market due to the employment uncertainty surrounding their husbands who have recently become jobless – a phenomenon known as the 'added worker effect'.

3.5 Contribution to the unemployment dynamics

Having presented the findings of the gross flows, transition rates and business cycle properties, we turn to evaluate the contribution of the various transition rates to the cyclical behaviour of the equilibrium unemployment rate. Several researchers to-date have studied the relative importance of the ins and outs of unemployment in an attempt to explore the unemployment rate volatility. Most notable being, Elsby et al. (2009), Fujita & Ramey (2009) and Shimer (2012) for the US economy whilst Petrongolo & Pissarides (2008), Smith (2011), Gomes (2012) and Silva & Vazquez-Grenno (2013) for the European economies. However, the focus has been on the developed countries largely due to the ample sets of micro-level data required to carry out such investigation successfully. The contribution to this volatility in each of the aforesaid studies is computed so far by taking into account transitions in a 2-state (employment and unemployment), 3-state (employment, unemployment and inactivity) or 4-state (permanent employment, temporary employment, unemployment and inactivity) model.

The following analysis is one of a kind for 2 reasons. First, the contribution of the transition rates to the dynamics of the unemployment rate will be observed for a developing country; something rarely observed in the past literature. Second, we implement a 6-state model by considering the employment quadrility of the Brazilian labour market, distinguishing between the transition rates that involve permanent employment and those involving temporary employment in the formal and informal sector respectively. Thereby, utilizing the equations (1)-(6) from Section 3.3.1, we compute the steady-states for FP_t, FT_t, IP_t, IT_t, U_t and I_t in each of the periods by

solving the following system of equations simultaneously as a function of the transition rates (Λ_t^{X-Y}).

$$-(\Lambda_t^{U-FP} + \Lambda_t^{U-FT} + \Lambda_t^{U-I} + \Lambda_t^{U-IP} + \Lambda_t^{U-IT})U_t^{SS} + \Lambda_t^{FP-U}FP_t^{SS} + \Lambda_t^{FT-U}FT_t^{SS} + \Lambda_t^{I-U}I_t^{SS} + \Lambda_t^{IP-U}IP_t^{SS} + \Lambda_t^{IT-U}IT_t^{SS} = 0 \quad (8)$$

$$-(\Lambda_t^{FP-FT} + \Lambda_t^{FP-U} + \Lambda_t^{FP-I} + \Lambda_t^{FP-IP} + \Lambda_t^{FP-IT})FP_t^{SS} + \Lambda_t^{FT-FP}FT_t^{SS} + \Lambda_t^{U-FP}U_t^{SS} + \Lambda_t^{I-FP}I_t^{SS} + \Lambda_t^{IP-FP}IP_t^{SS} + \Lambda_t^{IT-FP}IT_t^{SS} = 0 \quad (9)$$

$$-(\Lambda_t^{FT-FP} + \Lambda_t^{FT-U} + \Lambda_t^{FT-I} + \Lambda_t^{FT-IP} + \Lambda_t^{FT-IT})FT_t^{SS} + \Lambda_t^{FP-FT}FP_t^{SS} + \Lambda_t^{U-FT}U_t^{SS} + \Lambda_t^{I-FT}I_t^{SS} + \Lambda_t^{IP-FT}IP_t^{SS} + \Lambda_t^{IT-FT}IT_t^{SS} = 0 \quad (10)$$

$$-(\Lambda_t^{IP-FP} + \Lambda_t^{IP-FT} + \Lambda_t^{IP-U} + \Lambda_t^{IP-I} + \Lambda_t^{IP-IT})IP_t^{SS} + \Lambda_t^{FP-IP}FP_t^{SS} + \Lambda_t^{FT-IP}FT_t^{SS} + \Lambda_t^{U-IP}U_t^{SS} + \Lambda_t^{I-IP}I_t^{SS} + \Lambda_t^{IT-IP}IT_t^{SS} = 0 \quad (11)$$

$$-(\Lambda_t^{IT-FP} + \Lambda_t^{IT-FT} + \Lambda_t^{IT-U} + \Lambda_t^{IT-U} + \Lambda_t^{IT-IP})IT_t^{SS} + \Lambda_t^{FP-IT}FP_t^{SS} + \Lambda_t^{FT-IT}FT_t^{SS} + \Lambda_t^{U-IT}U_t^{SS} + \Lambda_t^{I-IT}I_t^{SS} + \Lambda_t^{IP-IT}IP_t^{SS} = 0 \quad (12)$$

$$-(\Lambda_t^{I-FP} + \Lambda_t^{I-FT} + \Lambda_t^{I-U} + \Lambda_t^{I-IP} + \Lambda_t^{I-IT})I_t^{SS} + \Lambda_t^{FP-I}FP_t^{SS} + \Lambda_t^{FT-I}FT_t^{SS} + \Lambda_t^{U-FT}U_t^{SS} + \Lambda_t^{IP-I}IP_t^{SS} + \Lambda_t^{IT-I}IT_t^{SS} = 0 \quad (13)$$

Figure B6 of Appendix B compares the evolution of the steady state unemployment rate, u_t^{SS} with the actual unemployment rate, u_t over the course of study. By and large, it seems both the rates follow each other closely throughout the phase with the largest deviations occurring when the actual unemployment increased rather sharply, particularly over the downturns and the Global recession of 2008-09. In spite of these differences, the steady state unemployment rate and actual unemployment rate depict a very high correlation of 0.978.

Based on this strong correlation, we approximate the contribution of the various transition rates to fluctuations in unemployment using the previously computed equilibrium unemployment rate. The methodology applied is first proposed by Shimer (2012) where the impact from each of the individual transition rate on steady-state unemployment is identified by constructing counterfactual values for FP_t^{SS}, FT_t^{SS}, IP_t^{SS}, IT_t^{SS}, U_t^{SS} and I_t^{SS}. These values are derived by allowing movements over time in just one transition rate whilst holding the remaining rates at their average values $\left(\overline{\Lambda}^{X-Y}\right)$. To be more specific, we work out the contribution of each transition rate through the coefficient from a regression of each de-trended counterfactual unemployment rate on the de-trended equilibrium unemployment rate.

To increase the robustness of our result, we further adopt the decomposition technique proposed by Fujita & Ramey (2009), which later has been extended by Silva & Vazquez-Grenno (2013) to our 6-state model. In particular, we breakdown the equilibrium unemployment rate by taking a first-order Taylor expansion around the HP-filter trend values of the hazard rates $\left(\overline{\Lambda}_t^{X-Y}\right)$ instead of around the constant means $\left(\overline{\Lambda}^{X-Y}\right)$. Then, from the first-order Taylor expansion we obtain the following expression.

$$\Delta u_t^{SS} = \frac{u_t^{SS} - \bar{u}_t^{SS}}{\bar{u}_t^{SS}} = \sum_{X-Y} \beta_t^{X-Y} \left(\frac{\Lambda_t^{X-Y} - \overline{\Lambda}_t^{X-Y}}{\overline{\Lambda}_t^{X-Y}} \right) + \varepsilon_t \qquad (14)$$

where, $\beta_t^{X-Y} = \frac{\delta \bar{u}_t^{SS}}{\delta \overline{\Lambda}_t^{X-Y}} \frac{\overline{\Lambda}_t^{X-Y}}{\bar{u}_t^{SS}}$ is the elasticity of the HP trend equilibrium unemployment rate with respect to the HP trend value of the hazard rate and ε_t is an error term. If the factor $\Delta u_t^{SS}(\Lambda_t^{X-Y})$ is defined as the contribution of the hazard rate (Λ_t^{X-Y}) to fluctuations in the equilibrium unemployment rate, the decomposition proposed in

equation (14) makes it possible to assess quantitatively the unemployment variability in terms of the separate contributions of each hazard rate. This in turn is expressed as a proportion of total variation as follows.

$$\chi^{X-Y} = \frac{cov\left(\Delta u_t^{SS}, \Delta u_t^{SS}(\Lambda_t^{X-Y})\right)}{var(\Delta u_t^{SS})} \tag{15}$$

Table B4 of Appendix B summarizes the contribution of the various transition rates to unemployment volatility to evaluate our case of employment quadrility. It is observed that the results from both the methodologies are quite similar when applied to the 6-state model. For Brazil, the movement in the transition rates from unemployment to employment (U-E) explain about 1% of the changes in the unemployment rate. In contrast, the movement in reverse i.e. the transition rates from employment to unemployment (E-U) contribute as much as 42% of all the fluctuations. This implies that job separate rates are more vital to account for the volatility in the Brazilian equilibrium unemployment rate which is in line with the findings of Bosch & Esteban-Pretel (2012). However, those authors argue based on data from PME-Antiga (between 1983 to 2001) that informal sector jobs dominate the separation rate (71 of 77%) whereas our results based on data from PME-Nova reflect that this dominance has diminished (30 of 42%) and thereby highlights the changing landscape of the Brazilian labour market. Interestingly, Fujita & Ramey (2009) and Elsby et al. (2009) in their research on the US labour market explain that accounting for dynamic interactions between job finding and separation rates by far raises the importance of the later in explaining unemployment volatility.

The employment quadrility of the Brazilian labour market is instantly recognizable when we consider the transitions in different types of employment contracts (permanent and temporary) and unemployment in the formal and informal sector. To be specific, about 65% of all movements between unemployment and employment involve permanent contracts. Although the transition rate from unemployment to formal permanent jobs (U-FP) has to largest positive contribution in the aggregate job finding rate to fluctuations in the unemployment rate, it is almost negated by the transition rate from unemployment to informal permanent jobs (U-IP). Furthermore, our findings illustrate that the variation in the transition rate from permanent jobs to unemployment is responsible for 26% of all movements in the unemployment rate which is shared almost equally by the formal (12%) and informal (14%) contracts. This result, combined with the cyclical behaviour of the transition rates from FP-U and IP-U in general as observed in Table B3 of Appendix B, somewhat contrasts the basic belief regarding permanent jobs as expressed in most of the theoretical literature. For instance, Sala et al. (2012) in constructing a matching model shows that following an aggregate productivity shock, job destruction rate in permanent contracts barely rises due to the presence of substantially high firing costs.

Conversely, the transition rates from temporary jobs to unemployment explain about 16% of fluctuations in the unemployment rate. In this case, informal temporary contracts (IT-U) are credited with the lion's share of these changes which is equivalent to 15%. In addition, we notice that about 62% of all movements from employment to unemployment are associated with permanent jobs. Although the transition rates involving all types of employment appear to be important in varying degrees to explain the cyclical fluctuations in the unemployment rate (particularly, permanent contracts in the formal sector and temporary contracts in the informal sector), our results confirm

that the transition rates involving permanent jobs have a more prominent role compared to those related to temporary. What's more, permanent employment plays a crucial role in job creation but even more so in job destruction.

In terms of the transition rates related to job-to-job movement, we perceive that all of them rather cancels out each other irrespective of the contract type. This implies that the net contributions from these transition rates are quantitatively minor to significantly affect changes in the unemployment rate. Lastly, the transition rates involving inactivity explains more than half (53%) of the fluctuations in the unemployment rate. The bulk of which is associated to the movement in the transition rate from inactivity to unemployment (I-U) (24%). Overall, all the transition rates involving formal contracts account for 27% of the fluctuations in the unemployment rate, almost all of which are associated to permanent jobs (26%). On the other hand, 32% of the movement in the unemployment rate are accredited to transition rates involving informal contracts where majority are linked to temporary jobs (20%) whilst the rest with permanent (12%). Therefore, this employment quadrility is crucial towards understanding the unemployment volatility, particularly in developing countries and in our scenario the functioning of the Brazilian labour market.

3.6 Conclusion

In this paper, we seek to observe the trends in the aggregate labour market outcomes for the Brazilian economy from 2nd quarter of 2002 till 4th quarter of 2014. Using new Monthly Employment Survey (PME-Nova), we have evaluated the gross flows and transition rates between different states, overtly taking into account the 4-tiered nature of labour markets in developing countries. Our findings propose that about 53% of the gross flows between employment and unemployment involve permanent contracts and it is more pronounced in the formal sector (55%). Temporary contracts make up the rest and are the chief source of employment in the informal sector (94%). Furthermore, inactivity constitutes approximately 44% of the working-age population where ins and outs significantly outpace that of unemployment similar to the Japanese labour market (Lin & Miyamoto, 2012). This implies that the stock of inactive workers is an important source of labour supply for the economy and therefore crucial for explaining the labour market activities in Brazil.

On the evolution in the ins and outs of unemployment, our study uncovers that the decrease in the aggregate unemployment rate is largely due to the increase in the number of workers being hired predominantly in the formal sector and an overall fall in the number of separations. This is consistent with the concept of increased formalization observed in the 21st century Brazil as put forward by several authors previously. In terms of the transition rates, counter-cyclical behaviour is observed generally from employment to unemployment and it is more pronounced in the share of temporary jobs which implies that the part-timers are often the first to be laid-off when the economy is performing below par. Although this outcome is particularly true for the formal sector, spikes during

the recessions indicate that individuals suffer equally irrespective of the contract type in the informal sector. Conversely, the transition rates to and from inactivity and employment follow a similar pattern as those concerning unemployment but with magnitudes that are almost twice as large.

A comparison of our results for Brazil with evidence from Spain, the UK and US reveals that interestingly, the Brazilian labour market operates as a mix of the European and US labour market. Although, we detect that the transition rate from unemployment to employment is nearly 10 times lower in Brazil compared to the US whilst the opposite is about 3 times smaller, these are more in line with the transition rates from the UK or Spain. On the other hand, the transition rates related to inactivity matches closely with those from the US but are significantly larger when compared to the European economies. The soaring transition rate from unemployment to employment and those to inactivity helps explain how the Brazilian unemployment rate fell from a high 13% in 2003 to a mere 4% by the end of 2014. Moreover, the notable movement to inactivity which are dominated by the informal contracts (i.e. both permanent and temporary) may have been influenced by the various welfare programs introduced by the Brazilian government with the aim to eradicate poverty, eliminate child labour and develop better human capital.

As for the business cycle properties, our findings are quite intuitive. There are pro-cyclical relationships between real GDP and the transition rate from unemployment to formal permanent and temporary jobs but counter-cyclical between real GDP and the transition rate from unemployment to informal permanent jobs. However, counter-cyclical behaviour is observed between real GDP and the transition rates involving all forms of

contract to unemployment except formal permanent which appears to be cyclically non-responsive. On the other hand, pro-cyclicality is found between real GDP and the transition rates from temporary jobs to inactivity whilst counter-cyclicality is perceived between real GDP and the transition rates from inactivity to unemployment, formal permanent jobs and vice versa. In terms of the job-to-job transition rates, there are important reallocations over the business cycle. Counter-cyclical behaviour is detected between real GDP and the transition rate from informal permanent to formal temporary jobs whereas pro-cyclical relationships are witnessed between real GDP and the transition rates from formal temporary jobs to formal permanent, from informal temporary jobs to formal permanent, from informal permanent jobs to formal permanent and from formal temporary jobs to informal permanent. Thus, with the economy performing well, more individuals move out of unemployment/inactivity in search for newly available jobs and those who are already employed opt for better jobs. Alternatively, rise in the number of separations during those recessionary periods or the lack of new jobs in the formal sector incline workers to move towards informality.

Finally, in our modelling, we go for a 6-state set-up taking into consideration employment quadrility (i.e. formal permanent, formal temporary, informal permanent and informal temporary) to resemble labour markets in developing countries. For Brazil, the movement in the transition rates from unemployment to employment and vice versa roughly explain 1% and 42% of all the fluctuations in the aggregate unemployment rate respectively. This result implies that job separation rate plays a more dominant role in accounting for the country's unemployment rate volatility similar to findings from the US. We observe that around 38% of the movement in the unemployment rate are explained by fluctuations in the transition rates involving permanent contracts, the lion's share of which are in the

formal sector (26%). Conversely, 21% of the changes relate to the transition rates associated to temporary contracts and almost all are from the informal sector (20%). In addition, more than 60% of the unemployment volatility are explained by movements between unemployment and employment involving transition rates to and from permanent jobs.

In terms of the transition rates related to job-to-job movement, we find that all of them somewhat cancel each other irrespective of the contract type. For the transition rates involving inactivity, it is observed that they account for 53% of the fluctuations in the unemployment rate; the bulk of which is associated to the movement in the transition rate from inactivity to unemployment. Although the transition rates involving all types of employment appear to be important in explaining the cyclical fluctuations in unemployment rate (particularly permanent contract in the formal sector and temporary contract in the informal sector), our results assert that the transition rates involving permanent jobs have a more prominent role compared to those related to temporary. What's more, permanent contracts play a crucial role in job creation but even more so in job destruction, hence, there is scope for policy implication. The transition rates involving permanent employment seem to hold the key in understanding the cyclical movement in Brazilian unemployment rate.

To conclude, through our research project we believe to have accomplished something unique i.e. we have revealed how the gross flows and transition rates in general between different states explain the evolution of the aggregate unemployment rate, focusing on a developing country like Brazil. Unfortunately, it is the first paper of its kind to carry out such a flow analysis and implement a 6-state model to resemble developing labour

markets accounting for temporary and permanent work in both formal and informal sector using data published in post-2002 period. Furthermore, Bosch & Esteban-Pretel (2012) highlight that the drastic modification of the PME-Antiga in 2002, particularly in the adopted methodology has made it impossible to reconcile the new and old definition of unemployment. Hence, we neither could directly compare our results with the previous studies on Brazil nor with similar studies on other countries. Ball et al. (2011) grieve how the lack of necessary data sets has hindered the study of labour markets in the developing nations over the past decades. Therefore, by evaluating the empirical evidence from the past 13 years in Brazil, we make a humble attempt to explore the unknown and add value to the existing labour market literature. However, there is still scope for much to be discovered which is why our results can come in handy for future researchers who seek to evaluate unemployment rate volatility in similar developing labour markets.

Chapter 4

Search and Matching in the presence of Informality: Evidence from Brazil*

Abstract

In this paper, we try to take a closer look at the dualistic nature of labour market in the developing countries where there are different tiers of informal job. First, using the new Monthly Employment Survey (PME-Nova), the size and cyclical patterns of gross flows and transition rates are analysed between different market states over the period 2002 to 2015. Next, a search and matching model is developed with 5-states where the formal sector is characterised by search friction whilst the informal sector is frictionless and perfectly competitive. Finally, the model is calibrated using the stylized facts from Brazil and a policy simulation is performed. Our findings suggest that a payroll tax aggravates labour market tightness and therefore on one hand, discourage firms to open more vacancies whilst on the other hand, diminish search intensity and willingness of workers to leave non-formal states. As a result, it plays an integral role in increasing both non-employment and the size of informality. What's more, such taxes have no effect on informal sector wage, however, there is a possibility where it may boost formal sector wage. Given that the latter is found to be at least 3 times greater than the former, this further widens inequality between the formal and informal sector.

* Please note that Chapter 4 is in collaboration with Dr Mathan Satchi and Dr Wei Jiang.

4.1 Introduction

For over 50 decades, the harmonic existence of formal and informal jobs in developing countries has been of interest for researchers and policymakers because business cycle fluctuations and labour market policy interventions have significant effects both on unemployment as well as allocation of workers between different employment states. Recent microeconomic evidence on countries with large informal sector has shown that although the volatility in unemployment from cyclical fluctuations are quite similar to those in developed countries, the reallocation over the business cycle are significant between formal and informal jobs (Bosch & Esteban-Pretel, 2012). In a cross-country survey, Schneider (2005) estimates that the average size of informality is close to 42% in Latin America, 41% in Africa, 38% in Eastern Europe, 26% in Asia and 17% in Western Europe when measured as a percentage of GDP. Despite the advancement in technology and improvement in monitoring such level of informality is tolerated since on one hand, the sector provides a vital source of unregulated and flexible labour for firms which allow them to operate effectively and in turn increase their incentives to invest in new technology (Almeida & Carneiro, 2005) whilst on the other hand, intensifying the degree of coercion leads to higher unemployment as they are the opposite sides of the same coin (Boeri & Garibaldi, 2005).

In the existing literature, there are two school of thoughts regarding how one views informality considering the dualistic nature of labour market in the developing countries. Some authors like Gong et al. (2004) and Fields (2009) highlight the informal sector to comprise of workers who cannot obtain the “good” formal job. The sector generally operates as a competitive market and therefore absorbs the excess workers from formal

sector. Alternatively, others such as Perry et al. (2007b) and Levy (2008) claim informal jobs as the consequence of voluntary choices made by workers in search of better pay or flexibility. This latter view has been supported by several empirical evidences particularly, from Latin American countries that describes informality as an unregulated micro-entrepreneurial sector (Maloney, 2004; Mondragón-Vélez & Peña, 2010). However, a few researchers for instance, Magnac (1991) and Pratap & Quintin (2006) seems to reject the whole idea of a segmented labour market since they observe no evidence of a formal sector wage premium after controlling for individual and establishment characteristics in Argentina and Colombia respectively.

In this paper, we hope to take a closer look at the dualistic nature of labour market in the developing countries within a search and matching framework where there are different tiers of informal job. Our contribution to the literature comes in the following ways. First, we examine the gross flows and transition rates for Brazil in a 5-state set-up (i.e. formal sector employment, informal salaried, self-employed, informal employer and non-employment) using new Monthly Employment Survey (PME-Nova) which has been modified in 2002 for greater coverage as well as better international comparability. Understanding flows are important since they tend to affect labour market indicators as well as fluctuations over the business cycle. Our research is quite different from others to-date, in that we look at post-2001 Brazil which has experienced a rise in formality. With micro-data at disposal, this is a unique opportunity to evaluate the recent dynamics in the Brazilian labour market.

Second, we develop a search and matching model in the tradition of Laing et al. (2005), Zenou (2008) and Satchi & Temple (2009) where formal sector is characterized by search

frictions whilst informal sector is frictionless and perfectly competitive. Based on the empirical evidence, we incorporate 3 key features to the model. First, we allow for the coexistence of formal and informal jobs in the labour market where workers decide between being formal or informal. Second, given the importance of gross flows and transition rates within informal sector, we allow for workers to sort themselves into different tiers of informal job such as informal salaried, self-employed or informal employer based on individual opportunities or abilities. This is an extension of the work by Zenou (2008) who never truly models these features explicitly but highlights the importance of self-employed and informal employer who start business by recruiting friends and relatives through the word-of-mouth communication. Third, we introduce the "non-overlapping property" which captures the idea that an informal employer will not move to non-employment given that her income is greater than the maximum as a non-employed. Lastly, we calibrate the model to match the set of stylized facts from the Brazilian economy and simulate it to show how well some of the main variables respond to a tax policy reform.

Our empirical results imply that in order to understand the functioning of the Brazilian labour market, it is important to consider a segmented labour market framework and focus on the different tiers of informal job. Specifically, we observe about 27% of the gross flows between employment and non-employment involve a formal sector job. The rest of the jobs are informal shared among informal salaried (40%), self-employment (31%) and informal employer (2%) respectively. Looking at the evolution of key labour market indicators, we notice that the overall fall in the aggregate non-employment rate at least till the end of 2012 is largely due to the number of workers being hired in the formal sector and an overall fall in the number of separations in line with Berg (2011). However,

the country experienced continuous macroeconomic crisis ever since which significantly lowered growth, accelerated inflation and adversely affected overall employment rate. For informal sector jobs, separation rate has been notably larger for informal salaried, particularly over the downturns and Global recession of 2008-09 whilst recently, job finding rate has picked up for self-employment. In terms of the transition rates, the general consensus is that those from informal sector jobs to non-employment and vice versa are significantly larger than the ones related to formal sector employment. Also, despite the fact that many of the important job-to-job transitions occur between sectors, we observe that the largest is from informal employer to self-employment.

Given that our theoretical model provides a framework for studying the effects of policy changes in the developing countries, we examine the impact from a tax policy reform. We show that such government intervention affects labour market outcomes by changing the incentive of both firms to create vacancies and workers to search for formal sector jobs. In particular, it is perceived that a rise in payroll tax rate aggravates labour market tightness by reducing firms' profits which deter them from opening more vacancies. This is accompanied by a fall in search intensity and willingness of workers to leave non-formal states. Therefore, put together, tax increases both non-employment and the size of informality. Our model also predicts that an increase in the tax rate worsens inequality between the formal and informal sector workers. This may be particularly true, if government transfers are tied to the tax rate and specifically targeted to boost industry activity leading to a productivity shock. In the end, formal sector wage will increase as long as the productivity gain outweighs the cost associated to the tax rise. Although higher wage may attract non-formal sector workers, matches will still be rare provided that fewer vacancies are opened due to the rising wage cost. Note that informal sector

wage has been found to be completely unaffected by changes in payroll tax rate in line with Botero et al (2004).

The early models by Diamond (1982a, b), Pissarides (1985) and Mortensen & Pissarides (1994) established the main building blocks of the search and matching models which attempted to understand intricacies of the labour market dynamics and policy implications with particular focus on developed countries. Nowadays, it has become a cornerstone in economics since it explains well how wages and unemployment are jointly determined in steady state when the labour market consists of heterogeneities, frictions and imperfect information. Researchers and economists prefer using these models because of the ease with which it can be implemented in the DSGE framework – a leading paradigm in macroeconomics. Yashiv (2007) emphasizes that the matching model has solved many of the issues that the neo-classical Walrasian model of frictionless labour market failed to address such as understanding the existence of persisting equilibrium unemployment, large and volatile gross flows i.e. worker transition, low cyclicality of real wage etc.

With the focus gradually shifting towards the developing countries, several extensions have been made to explore the presence of informality in models with search frictions and understand how policies affect equilibrium in these labour markets. Boeri & Garibaldi (2006) and Albrecht et al. (2009) argue that workers are sorted to jobs based on the productivity difference. Using calibration data from OECD countries, the scholars investigate how changes in policies such as severance, payroll and production taxes affect the informal sector composition and size as well as the impact on unemployment rate. Kolm & Larsen (2001) and Fufazza & Jacques (2003) adopt models where workers direct

their job search based on some moral value. The idea is that workers with high moral will be compelled to pursue jobs that are strictly in formal sector and vice versa. Dolado et al. (2009) highlight that workers are categorized based on the level of education attained where more educated workers are considered for skilled jobs whilst unskilled ones can be filled in by anyone. Therefore, shifts in demand and supply of higher skills have a milder impact on the unemployment rate of the less educated in models that ignore on the job search.

Bosch & Esteban-Pretel (2012) propose a model where firms hire workers based on the ex post match productivity. Workers are homogeneous but when a match is formed, productivity of the employment relationship is revealed which leads to heterogeneity. The researchers use calibration data from Brazil to evaluate how changes in various policies impact share of formal employment and welfare. Kugler (1999) assumes that ex ante productivity levels govern how firms sort themselves into formal or informal status where workers are matched randomly to these firms. Bouev (2002) and Ulyssea (2010) suggest that workers may search randomly and with the same intensity in both sectors. However, entry probabilities differ and therefore demand and supply condition in one sector significantly impact decision of workers in the other. Similar to Albrecht et al. (2009), they analyse how the size of informality and unemployment are affected when changes are made to policies such as unemployment benefits, regulation of entry and enforcement using calibration data from Eastern European countries and Brazil respectively.

Inspired by the work of Harris and Todaro (1970) on rural-urban migration, Zenou (2008) designs a model where the formal sector is characterized by search frictions whilst the

informal sector is fully competitive. His idea is rooted on the fact that workers in informal sector either create their own business (self-employed, entrepreneur) or work for friends and relatives where jobs are often found through the word–of–mouth communication. Hence, coordination failures and search frictions are considerably low. Conversely, formal sector jobs have to be advertised and workers screened before matches can occur which is time consuming and costly. In similar settings, Laing et al. (2005) investigates how the "Hokou" system (which restricts the free movement of workers between rural and urban areas in China) affects internal migration, job finding rate and unemployment rate whilst using calibration data on Mexico, Satchi & Temple (2009) reveal how growth impact labour market outcomes in both the formal and informal sector where only the former is characterized by search frictions.

The remainder of the paper is organized as follows. In Section 4.2, we introduce the database and conduct a flow analysis. Section 4.3 explains the adopted methodology and presents our evaluation of the transition rates. In Section 4.4 we discuss the model and characterize its steady state. Section 4.5 describes the assumptions for calibration and examines simulation results and finally, Section 4.6 concludes.

4.2.1 Data: PME-Nova

For the empirical investigation, we once again obtain data from new Pesquisa Mensal de Emprego (PME-Nova)[1] i.e. the Brazilian Monthly Employment Survey conducted by the Instituto Brasileiro de Geografiae Estatistica (IBGE) which enables us to compute with accuracy not only the size of informality but also gross flows by tracking the month-to-month transition of workers between different market states. In particular, our interest is in a 5-state model (involving formal sector employment, informal salaried, self-employed, informal employer and non-employment) where we explicitly consider formal and different tiers of informal job documented in the developing countries. Note that PME-Antiga (i.e. old PME) concepts and methodology underwent drastic modification in 2002 and more recently, the survey has been discontinued and replaced by the Continuous National Household Sample Survey (Continuous PNAD) in 2016 to encompass the whole country. Therefore, our research time span is restricted between 2nd quarter of 2002 (starting quarter of the new micro-data series) and 4th quarter of 2015.

A major problem that arises when dealing with informality is that information on contract status is often non-existent for illegal employment and in case of self-employment or own account workers such measure makes little sense as they cannot contract themselves. Henley et al. (2006) assert that the informal sector in Brazil has attracted particular attention for research since it is mandatory for employers to notify workers whether their employment relationship is legally binding and as such the third parties such as statistical agencies can establish with some degree of accuracy the size of informality. As mentioned previously, there are several reasons why individuals may work informally. For instance,

[1] Review Section 3.2.1 of Chapter 3 to learn more about the structure of PME, challenges faced when using the survey and adjustments required to construct the correct flows.

some prefer flexibility that comes with it; others find self-employment to be more attractive whilst many may be displaced involuntarily. In Brazil, substantial lay-off cost in termination of formal contracts and payroll tax in excess of 30 % of a worker's wage (one of the highest in Latin American countries) both work hand-in-hand, influencing firms and individuals to work without registration (World Bank, 2002; Hoek, 2007).

Generally speaking, there is a broad consensus in the literature on what constitutes informality and studying transitions often raises some particular definitional complexities. We follow the International Labour Organization (ILO) definition in dividing the employed workforce into different states. Bosch & Maloney (2008) explain formal sector workers as individuals with a registered work permit (or "*carteira de trabalho*" as it is commonly called in Brazil) and works in firms licensed with the government in compliance with tax and labour laws including workplace standards for safely, minimum wage directives, pension and health benefits etc., granting them access to all forms of labour protection. On the other hand, workers whose contracts are not registered or owners of micro firms which are largely de-linked from the state institutions/obligations and as such individuals working in them are not covered by labour protection are considered to be informal.

We go further and disaggregate informal sector into 3 broad categories based on the emphasis put forward by Maloney (2004) and Mondragón-Vélez & Peña (2010) where they refer to it as an unregulated micro-entrepreneurial sector. In line with Jakoson et al. (1996), we argue that if individuals are salaried workers in firms without a work permit, they are informal salaried; if individuals work for themselves and provide service directly to consumers (excluding professionals or technicians), they are self-employed; if individuals are owners of micro firms or family owned businesses with salaried informal

workers that do not conform to government regulations and labour laws, they are informal employer. Finally, we aggregate the pools of unemployed and inactive and refer to the merger as non-employment. Although this is an unconventional approach since the former include individuals not working, currently available and actively looking for a job within a specific reference period whilst the latter comprise of individuals out of labour force, in case of Brazil, important reallocations take place between employment and aforementioned states over the business cycle.

4.2.2 Average gross flows

Figure C1 of Appendix C summarises the monthly average gross flows between the 5 market states namely, formal sector employment, informal salaried, self-employment, informal employer and non-employment over the period 2002 to 2015. It documents the stock of workers in each state in thousands (t) and as a percentage of the working-age population (p) as well as the number of individuals that change state every month as a percentage of the working-age population (p) and as a transition probability or hazard rate (h). We observe that the formal sector employs 25.26% of the working-age population whilst the informal sector employs 26.19% of the working-age population split between informal salaried (13.95%), self-employment (9.92%) and informal employer (2.32%), signifying 49%, 27%, 19% and 5% of total employment respectively.

Over the whole period, net employment increases by an average of 100 per month which represents 0.14% of the working-age population. Underlying this net increase in total employment are the various flows that help explain the key features of the Brazilian labour market. According to our computation, approximately 27% of the gross flows between employment and non-employment involve a formal sector job. The rest of the jobs are informal shared among informal salaried (40%), self-employment (31%) and informal employer (2%) respectively. Berg (2011) proclaims that since the early 2000s, there has been a move towards formalization in Brazil, attributed to the growth and de-centralization of public spending, the growth of domestic credit, the growth and diversification of export, the Simples law (a new system of tax exemption and simplification for small and micro enterprises) and improvements in labour intermediation and inspection. This is evident from the data as well which indicates that

net employment in the formal sector increases by an average of 82 per month (0.10% of the working-age population) compared to the informal sector where the average is about 18 per month (0.04% of the working-age population).

Next, we disaggregate the gross flows based on the job types to understand the intricacies of the Brazilian labour market and how it creates employment. Every month on average 0.63% of the working-age population move from non-employment to formal sector employment whilst 0.67% move in the opposite direction. Conversely, the flows between non-employment and informal salaried are considerably larger with an average of 0.90% and 1.02% of the working-age population respectively moving each month to and from non-employment. Alternatively, on average each month 0.76% of the working-age population move from non-employment to self-employment whilst 0.70% move in the reverse. Conversely, the flows between non-employment and informal employer are the smallest with an average of 0.05% of the working-age population moving each month to and from non-employment.

In addition to the flows between non-employment and employment, there are a significant number of workers that move between different types of job. First, if we only consider the flows between the formal and informal sector, it is found that on average 1% of the working-age population move per month from formal sector employment to informal salaried and 1.13% move in the opposite direction; 0.23% of the working-age population move per month from formal sector employment to self-employment and 0.24% in the reverse and lastly, 0.06% of the working-age population move per month from formal sector employment to informal employer and vice versa. Second, allowing only for the flows within the informal sector, it is observed that on average 0.53% of the

working-age population move per month from informal salaried to self-employment and 0.54% in the opposite direction; 0.27% of the working-age population move per month from self-employment to informal employer and vice versa and lastly, 0.08% of the working-age population move from informal employer to informal salaried and vice versa.

Although the relative magnitude of the flows from non-employment to the different types of employment and between their respective states appear quite substantial, it should not come as a surprise given the country's unusually high turnover rate. According to a government study conducted by the Secretariat for Strategic Affairs in 2013 reveals that on average 40% of all Brazilians leave workforce within a given year which for low-paid jobs soar up to 80%. A number of reasons have been identified behind such behaviour of individuals, for instance, no perception of professional growth (31%), challenging hierarchical relations (26%), lack of incentives and benefits (17%), insufficient alternatives that promote a balance between personal and professional life (15%), contract non-compliance (5%), working over-time (5%) and plans for establishing own business (1%) etc. Whilst employers are bounded by law where a month's notice is compulsory before firing, there is no such binding for workers who can turn up and resign. It is argued that the root of this mentality is cultural where perhaps working is considered as an obligation rather than an enterprise.

Note that our findings thus far highlight 3 important aspects of the Brazilian labour market. First, there are substantial movements between non-employment and formal employment. Bourguignon & Dethier (2005) argue that educated individuals, particularly young workers often face high level of mismatch in jobs which generate the incentive to move according to their skill-sets. On top of that, Filho & Scorzafave (2009) highlight that

the Brazilian firms by law are required to pay compensation equivalent to 40% of all their obligatory savings accumulated on the job from Severance Indemnity Fund (FGTS) for unjust dismissal. It not only perversely motivates formal sector workers to often change jobs but also discourage firms to hold on to the same workforce for long. Second, the flows to formal sector employment are much larger from non-employment with the exception being informal salaried. Zenou (2008) accentuates that it is much more challenging for informal sector workers to find formal sector jobs due to the time involved in completing the matching process which is something they may not be willing or able to afford. However, given the large number of informal workers that predominantly micro Brazilian firms employ (due to the significant overhead costs involved in offering formal contracts), it may be time-saving and cost-effective to retain the existing workforce through contract conversion as and when required than going about advertising, screening and eventually recruiting a fresh worker from non-employment. Finally, the stock of workers as well as the flows are the smallest to and from informal employer. This is consistent with Marcouiller et al. (1997) who after observing several Latin American countries proclaim that self-employment and informal salaried are the more prevalent job types in the informal sector.

4.3 Worker transition in the labour market

Given the panel dimension of PME-Nova, we evaluate the dynamics of the Brazilian labour market with the help of transition rates focusing on their behaviour over the economic crises in the post-2000 period.

Figure C2 of Appendix C portrays the evolution of the key labour market indicators over the period of study. Based on the data, the overall employment rate mostly has a distinct upward trend, averaging around 51%, slowing down over the downturns, significantly dipping during the Global recession lasting 2 quarters till March 2009 and has been on a free fall ever since peaking at 55% by the end of 2012. Conversely, the non-employment rate is a mirror image of the overall employment rate with a primarily visible downward trend, averaging around 49%, significantly rising in recessions, peaking around 53% in the early 2002, gradually falling over time to a low 45% but ever since the late 2012, has been soaring again. Oreiro & D'Agostini (2016) explain that although the Brazilian economy generally experienced good GDP growth rate (4.06% per year) and moderate level of inflation rate (5.79% per year in CPI), the dramatic change in the macroeconomic performance was brought about by the stagnation of industrial output which began by the end of 2010. On one hand, there was the continuous overvaluation of the exchange rate and on the other hand, there was the profit squeeze resulting in the Brazilian firms losing their external competitiveness. As profit margins declined so did investment in new machinery and equipment, worsening the productivity problem of the manufacturing sector and in turn affecting employability rate.

Figure C3 of Appendix C illustrates the evolution of the share of different types of employment over the period of study. Looking at formal sector employment (top left

panel), there appears to be a distinct upward trend which averages around 49% of the overall employment, peaking at 55% and gradually slowing down since the late 2013 onwards. This is consistent with Berg (2011) who highlights that Brazil has experienced a rise in formal sector employment since the early 2000. In case of informal salaried (top right panel), it is the opposite i.e. we observe a visible downward pattern which averages around 27% of the overall employment, peaking at 31% and in recent times hovering about 23%. Note that informal salaried has been the most affected among all the job types during the Global recession of 2008-09. Hoek (2007) implies that in a typical lay-out particularly within small firms, core workers are formally employed whilst those who are less essential are handled informally. This drastic fall in the data during crisis maybe a result of these latter workers being laid off.

Looking at self-employment (bottom left panel), there seems to be a gradual downward trend reaching 18% of the overall employment by the late 2011 but thereafter it rapidly soars past 20% by the end of 2015. On average self-employment is about 19% of the overall employment and this sharp rise may be a consequence of individuals dropping out of the manufacturing sector which was worst hit by the exchange rate overvaluation and profit squeeze as previously mentioned. Oreiro & D'Agostini (2016) reveal that in the period 2011-14, Brazil's average GDP growth rate fell to 1.59% per year and inflation accelerated to 6.17% per year from 4.06% and 5.79% respectively prior to 2011. Last but not the least, for informal employer there is not much change over the period of survey. It is by far the smallest pool of individuals which may be due to the challenges involved into operating outside the regulatory system. On average informal employer is about 4.5% of the overall employment, peaks at 5.4% in the mid-2003 and then sluggishly falls to 4.0% by the end of 2015.

Based on the discussion above, it would appear that decrease in the aggregate non-employment at least till the end of 2012 may be explained by an increase in the number of formal sector workers being hired and an overall fall in the number of separations. However, Brazil experienced continuous economic crisis ever since which significantly slowed down growth, accelerated inflation and adversely affected employment. During this period of crisis, the behaviour of labour market is as expected and the visible rise in the aggregate non-employment may be interpreted as an overall increase in the number of workers losing jobs and a fall in the number of hiring. Surprisingly, self-employment has picked up which probably has something to do with the fact that other types of job were proving difficult to come by and as a result these workers moved onto the next best alternative.

Having analysed the figures for Brazil, it is now in our interest to compute the transition rates. Let $\bigwedge_t^{X-Y}$ denote the transition rate from state X in period $t-1$ to state Y in period t. These transition rates are then computed as a fraction of the flows from state X to state Y and the number of individuals in state X at period $t-1$. For instance, the transition rate between self-employment and informal employer $\bigwedge_t^{SE-EM}$ is obtained as N_t^{SE-EM}/SE_{t-1}, where N_t^{SE-EM} is the number of individuals moving from self-employment to informal employer between period $t-1$ and t.[2] Note that we seasonally adjust the transition rates using the Census Bureau's X-13 program to account for the seasonal influence. In addition, these transition rates may represent time aggregation bias given that they fail to capture the presence of multiple transitions within a given period. Therefore, we re-compute the monthly transition rates implied by the weekly rates in our 5-state set-up. To be specific, the Markov-Chain transition matrix is applied to

[2] Where X and $Y \in \{NE, FE, IE, SE, EM\}$.

compute the weekly (w) transition rates from the seasonally adjusted monthly (m) transition rates and the system of equations characterized by equation (1) below.

$$\Lambda_{m,t}^{ij} = \sum_{k}\sum_{l}\sum_{n} \Lambda_{w,t}^{ik}\Lambda_{w,t}^{kl}\Lambda_{w,t}^{ln}\Lambda_{w,t}^{nj}, \quad i,j,k,l,n \in \{NE, FE, IE, SE, EM\} \tag{1}$$

Although it may result in the transition rates being upward biased, we are assuming that an individual's labour market status doesn't change within a given week which is consistent with the ILO definition. Once the weekly transition rates are obtained, we simply multiply them by 4 (i.e. 4 weeks in a month) to obtain the corrected seasonally adjusted monthly transition rates. Table C1 of Appendix C depicts these Brazilian monthly transition rates.

At a glance, the transition rates seem to differ significantly between the formal and informal sector as well as among different tiers of informal job. We notice that the transition rates from employment to non-employment are particularly dominated by informal sector jobs for instance, self-employment (7.62%) and informal salaried (6.98%) with the exception being informal employer which has a magnitude of only 1.94%. Conversely, the transition rate from formal sector employment to non-employment is about 2.67%. Aside from the country's social beliefs and strict labour laws (discussed in Section 4.2.2) that fuelled the high turnover rate, the Brazilian government introduced several welfare programs such as the *Bolsa Família* which came into full effect in the early 2000 with the aim to alleviate poverty, eliminate child labour and develop better human capital. These are cash transfer schemes that require individuals earning below the threshold per capita income (R$50 per month at its inception in 2004) to meet certain

conditions to become eligible.[3] All these factors in varying degrees may have contributed towards the aforementioned transition rates.

On considering the transition rates in reverse, i.e. from non-employment to employment, we perceive a similar pattern where the transition rates related informal salaried (2.23%) and self-employment (1.67%) are larger compared to formal sector employment (1.29%) and informal employer (0.09%). However, the magnitude of these transition rates generally is much smaller. Although it is difficult for us to make any direct comparisons (largely because we are looking at transitions to and from non-employment and not unemployment), in the broader sense, our findings are supportive of the literature including Bosch & Esteban-Pretel (2012) that the transition rates associated to job destruction dominates the dynamics of the Brazilian labour market and therefore, the key to understanding the cyclical fluctuations. Note that the transition rate from self-employment to non-employment is larger than that from informal salaried whilst it is the other way around from non-employment to those job types. Also, the transition rate from formal sector employment to non-employment are very similar to those from the US (3.16%) as reported by Silva & Vázquez-Grenno (2013).

In terms of the job-to-job transitions, we observe that many of the important transition rates are those from informal sector jobs such as informal salaried (9.07%), informal employer (2.89%) and self-employment (2.45%) to formal sector employment. This is consistent with the argument of increased demand for formal sector workers since the early 2000 as documented by Berg (2011). Conversely, the magnitude of the transition rates from formal sector employment to informal sector jobs such as informal salaried

[3] Eligibility criteria includes whether those families with children between the ages of 6 and 17 are attending schools and timely vaccinated; in case of pregnant women, whether they are performing all prenatal and postnatal check-ups etc.

(4.45%), self-employment (0.91%) and informal employer (0.25%) are comparatively smaller. Once more, our findings are in line with Ulyssea (2010) who expresses that most transitions from informal sector jobs to formal sector employment occurs from informal salaried. What's more, it is found that the largest job-to-job transition is from informal employer to self-employment (13.80%) whilst other notable transition rates revolve around informal sector jobs including those from self-employment to informal salaried (6.18%), from informal salaried to self-employment (4.30%), from informal employer to informal salaried (3.59%) and from self-employment to informal employer (3.21%).

Lastly, the focus is put on the aggregate transition rates between formal sector employment and overall non-formal states. We observe that the magnitude of the aggregate transition rate from formal sector employment to overall non-informal states is 8.27% whilst the opposite i.e. the aggregate transition rate from overall non-formal states to formal sector employment is 3.76%. Note that in equilibrium the overall flow from formal sector to non-formal states must equal the overall flow from non-formal states to formal sector. Hence, to arrive at these values a different technique is implemented than the one discussed above. In the former, we sum all the probabilities that capture the transition from formal sector employment to overall non-formal states (i.e. non-employment, informal salaried, self-employment and informal employer) whilst in the latter, we apply the Bayes' Theorem and take a weighted average of all the probabilities associated to the transitions from overall non-formal states to formal sector employment respectively.

4.4.1 Matching model

In the spirit of Laing et al. (2005), Zenou (2008) and Satchi & Temple (2009), we develop a continuous time search and matching model in a segmented labour market framework where the formal sector is characterized by search frictions (Mortensen & Pissarides, 1999; Pissarides, 2000) whilst the informal sector is frictionless and perfectly competitive. In the light of evidence presented earlier, we implement 3 key features to the model. First, we allow for the coexistence of formal and informal jobs in the labour market where workers decide between being formal or informal. It is assumed that firms post generic vacancies and when a worker arrives, they decide on establishing employment relationship based on the quality of the match. Second, given the importance of gross flows and transition rates within the informal sector, we allow for workers to sort themselves into different tiers of informal job such as informal salaried, self-employment and informal employer based on individual opportunities or abilities. This is an extension of the work by Zenou (2008) who never truly models these features explicitly but highlights the importance of self-employed and informal employer in the informal sector who start businesses by recruiting friends and relatives through the word-of-mouth communication. Third, we introduce the "non-overlapping property" which captures the idea that an informal employer will not transition to non-employment given that her income is greater than the maximum as a non-employed.

As in the standard search and matching model, we presume that both firms and workers meet in the labour market to form employment relationships. Matches occur randomly and according to the matching function, $m = m(u, v)$ where u is the number of non-formal workers and v is the number of vacancies. The matching efficiency, m is

homogeneous of degree 1 which is increasing and concave in both arguments. Workers are ex ante identical and supply a single unit of labour inelastically. This implies indivisibility of labour to the extent that it is not possible to divide work between 2 different states. For instance, a self-employed individual has to use the whole of her one unit of labour on self-employment. When a match is formed the productivity of the employment relationship is revealed and that leads to heterogeneity. For a match, the joint surplus arising from the meeting between a worker and a firm needs to exceed the sum of the values if they remain unmatched. Provided that the former is true, the joint surplus is divided according to the Nash solution to a bargain problem. Production then continues until a negative idiosyncratic shock arrives at which point the productivity of the job is again evaluated. If the value falls below a certain threshold, the job gets destroyed. The worker then returns to one of the non-formal states whilst the firm decides to either withdraw or re-open a job as new vacancy and thereby, the process continues. Table C2 summarizes the states, notations and respective incomes in the model.

Table C2: States and incomes.

State	Label	Fraction	Value to agent i	Income
Non-employment	U	γ_U	$U(a_i, b_i)$	b_i
Informal salaried	Z	γ_Z	$Z(a_i, b_i)$	w_I
Self-employment	S	γ_S	$S(a_i, b_i)$	$p_I a_i$
Informal employer	T	γ_T	$T(a_i, b_i)$	$p_I a_i(1+L)^{\zeta} - w_I L;\ \zeta < 1$
Formal sector employment	W	γ_W	$W(a_i, b_i, \xi)$	$w_F(a_i, b_i, \xi)$

We use for example, U both as a label for non-employment and for the value function $U(a_i, b_i)$ which denotes the present-discounted value of expected income in non-

employment. The fraction of workers in state X is represented by γ_X which means that the sum of all the fractions should equal to the working-age population, so $\gamma_U + \gamma_Z + \gamma_S + \gamma_T + \gamma_W = 1$. We also use $\tau(X, Y)$ to signify the average transition rate from state X to state Y, so for instance, $\tau(S, T)$ is the transition rate from self-employment to informal employer.

For worker i, income in non-employment is given by b_i and productivity in self-employment and as an informal employer is determined by a_i. The latter may represent individual opportunities or abilities[4] and is subject to shocks with a Poisson arrival rate λ_a at which point the new value of a_i is drawn from a distribution $G_a(a_i, a_i^-)$ with a density $g_a(a_i, a_i^-)$ where a_i^- is the old (or existing) value of a_i. This allows for an additional dimension of persistence in the process governing a_i, which, for instance, could be important if a_i primarily represents ability. Idiosyncratic shocks to b_i also arrive with a Poisson arrival rate λ_b where the new b_i is drawn from a distribution $G(b_i)$ with a density $g_b(b_i)$ which is assumed to be independent of the old value for simplicity. To keep track of the distributions, we argue that this arrival process for shocks to $a_i$and $b_i$ceases during formal sector employment.

[4] According to Stein et al. (2013), the credit markets in the developing countries are not well-developed, regulatory and legal frameworks are weak, informational asymmetries are persistent and risk management systems are not as robust, therefore, its support to businesses, contribution to economic growth and in turn job creation is rather limited. On top of that, Ayyagari et al. (2010) proclaim that funding for the informal operators are typically in the form of small unsecured short-term loans obtained either from friends and families or non-market institutions such as credit cooperatives, moneylenders, etc. that don't rely on formal contractual obligations enforced via a codified legal system but instead on the relationship and reputation of the individual concerned. Thus, we don't explicitly model for the credit markets. However, given that a_i represents the ability of an individual, it could very well include her ability to access loans from such informal financial institutions enabling her to pursue a career as a self-employed or informal employer.

4.4.2 Formal sector

As in Mortensen & Pissarides (1999) and Pissarides (2000), the formal sector jobs are characterized by matching frictions which arise due to coordination failures. For instance, consider that if only one worker can occupy one job, then, an uncoordinated application procedure by workers will cause overcrowding in some jobs whilst no applications will be placed for others. This lack of knowledge about other workers' action (i.e. to which firms these workers have send their job applications) results in search frictions leading to the existence of non-employment and vacancies in equilibrium. Suppose v is the vacancy rate, the labour market tightness θ is given by

$$\theta = \frac{v}{\gamma_U + \phi(\gamma_Z + \gamma_S + \gamma_T)} \tag{2}$$

where $0 < \phi < 1$ represents the probability of being matched with a formal sector vacancy for states Z, S and T relative to the probability in state U. This captures the idea that when in an informal sector job such as informal salaried, self-employment or informal employer, it is more challenging to search for work than when non-employed. Therefore, the latter faces a matching probability of $m(\theta)$ and the former $\phi m(\theta)$. Albrecht et al. (2009) make a similar assumption and sets $\phi = 0$.

All firms in the formal sector are ex ante homogenous and their probability of filling a vacancy is given by $\frac{m(\theta)}{\theta}$. On the other hand, all workers are risk neutral, infinitely lived and face a future discount rate, r. As firms and workers meet in the labour market, productivity of the match is revealed and heterogeneity arises. Let the match specific heterogeneity be ξ drawn with a Poisson arrival rate λ_ξ from a probability density $f(\xi)$

and its initial value at the beginning of the match be ξ^0 drawn from a probability density $f^0(\xi^0)$. Given the match, a worker receives wage w_F and production continues until a negative idiosyncratic shock arrives and lowers the match productivity. If the value falls below the cut-off point, the job is destroyed at an exogenous rate δ at which point the worker moves to one of the non-formal states i.e. non-employment, informal salaried, self-employment or informal employer. Under these assumptions, the value function of formal sector employment is given by

$$rW(a_i, b_i, \xi) = w_F + \lambda_\xi \int [max\{W(\xi, a_i, b_i), U(a_i, b_i), Z(a_i, b_i), S(a_i, b_i), T(a_i, b_i)\} \quad (3)$$

$$-W(\xi, a_i, b_i)]f(\xi)d\xi + \delta[max\{U(a, b_i), Z(a, b_i), S(a, b_i), T(a, b_i)\} - W(a, b_i, \xi)]$$

4.4.3 Non-formal sector

In the non-formal sector, workers must decide how actively to search for a formal sector job and considering the search intensity, different workers face different probabilities of being matched with a vacancy. We assume that informal employers face decreasing returns but no matching frictions. They pay a wage w_I to the informal salaried equivalent to the marginal product of labour and receives a fraction of profit as income equivalent to $p_I a_i(1+L)^{\zeta} - w_I L$. Production continues until idiosyncratic shocks arrive at the rate of λ_a and λ_b which then determines if the job is destroyed and thereafter the movement of workers to other states. Under these assumptions, the value functions of informal employer and informal salaried are given by

$$rT(a_i,b_i) = \max_L\left[p_I a_i(1+L)^{\zeta} - w_I L\right] + \phi m(\theta)\int max\left[W(\xi^0,a_i,b_i) - T(a_i,b_i)\right]f^0(\xi^0)d\xi^0 \quad (4)$$

$$+\lambda_a\int[max[U(a,b_i),Z(a,b_i),S(a,b_i),T(a,b_i)] - T(a_i,b_i)]g(a|a_i)da$$

$$+\lambda_b\int[max[U(a_i,b),Z(a_i,b),S(a_i,b),T(a_i,b)] - T(a_i,b_i)]g_b(b|b_i)db$$

$$rZ(a_i,b_i) = w_I + \phi m(\theta)\int max\left[W(\xi^0,a_i,b_i) - Z(a_i,b_i)\right]f^0(\xi^0)d\xi^0 \quad (5)$$

$$+\lambda_a\int[max[U(a,b_i),Z(a,b_i),S(a,b_i),T(a,b_i)] - Z(a_i,b_i)]\,g(a|a_i)da$$

$$+\lambda_b\int[max[U(a_i,b),Z(a_i,b),S(a_i,b),T(a_i,b)] - Z(a_i,b_i)]\,g_b(b|b_i)db$$

In case of self-employment, we assume that the individual provides service by herself and do not employ any outside help. Therefore, her earning is solely based on the productivity

of her job as well as her ability i.e. $p_I a_i$. All other things aforementioned, remains the same. Under these assumptions, the value function of self-employment is given by

$$rS(a_i, b_i) = p_I a_i + \phi m(\theta) \int max\,[W(\xi^0, a_i, b_i) - S(a_i, b_i)] f^0(\xi^0) d\xi^0 \quad (6)$$

$$+\lambda_a \int [max[U(a, b_i), Z(a, b_i), S(a, b_i), T(a, b_i)] - S(a_i, b_i)] g(a|a_i) da$$

$$+\lambda_b \int [max[U(a_i, b), Z(a_i, b), S(a_i, b), T(a_i, b)] - S(a_i, b_i)] g_b(b|b_i) db$$

Finally, we assume that individuals who are not working only receive an income equivalent to b_i but as stated previously has a higher probability $m(\theta)$ to land a formal sector job. All other things aforementioned, remains the same. Under these assumptions, the value function of non-employment is given by

$$rU(a_i, b_i) = b_i + m(\theta) \int max\,[W(\xi^0, a_i, b_i) - U(a_i, b_i)] f^0(\xi^0) d\xi^0 \quad (7)$$

$$+\lambda_a \int [max[U(a, b_i), Z(a, b_i), S(a, b_i), T(a, b_i)] - U(a_i, b_i)] g(a|a_i) da$$

$$+\lambda_b \int [max[U(a_i, b), Z(a_i, b), S(a_i, b), T(a_i, b)] - U(a_i, b_i)]\, g_b(b|b_i) db$$

4.4.4 Some simplifications

To solve our model, we need to find the wage w_I that clears the informal labour market. However, it will be impossible unless we know the distribution of a_i among informal employer. Perhaps some simplifications can be carried out to make this mathematically simpler. Let us define the following property, which we refer to as the "non-overlapping property".

Definition: We say an equilibrium satisfies the non-overlapping property if, for any agent $j \in T$ (i.e. any informal employer) and for any agent $i \in U$ (i.e. any non-employed individual), the supports of the unconditional distributions of a_j, b_j, a_i and b_i in equilibrium are such that $T(a_j, b_j) > U(a_i, b_i)\ \forall\ i, j$.

If this property is approximately true in the data i.e. if most informal employer are better off than most non-employed individuals and the model captures this, then the simplifications should not come at the cost of an excessive loss in the model's ability to fit the data. Thus, consider the ensuing quantities:

$$\psi_1 = \frac{\tau(T,W)}{\tau(U,W)} = \phi\frac{\Upsilon_T}{\Upsilon_U} \quad ; \quad \psi_2 = \frac{\tau(U,T)}{\tau(S,T)} \tag{8}$$

As discussed previously, $\phi \leq 1$ is the ratio of the matching probability for the informal employer to that of the non-employed and here Υ_X is the average probability of a worker in state X accepting a job provided the match. Considering the non-overlapping property, informal employer will have a higher threshold for ξ^0 to accept a job so we would expect

$\Upsilon_T \leq \Upsilon_U$[5]. Indeed, we would only expect $\Upsilon_T = \Upsilon_U$, if formal sector jobs "are always the best" so that the value of these jobs are such that workers in the non-formal states always tend to accept them. In the data, however, $\psi_1 > 1$ which may be due to the fact that informal sector jobs are simply viewed as entry points into the labour market where individuals hone their skills before venturing for formal sector opportunities (Perry et al., 2007b). Given the model complexities, in what follows, we consider $\psi_1 = 1$ which would imply $\phi = 1$ and so $\Upsilon_T = \Upsilon_U$ indicating that formal sector jobs are sufficiently more desirable where individuals in non-formal states always tend to except them when a matching opportunity arises. Hence, there is also little to be lost by assuming that ξ^0 is the same for all matches (so $f^0(.)$ is a degenerate distribution).

It comes from the value functions above that a worker will only transition from self-employment to being an informal employer if she experiences a positive shock to her productivity, a_i. If the non-overlapping property holds, the same will be true for transitions from non-employment to being an informal employer[6]. When a productivity shock occurs to a worker with current productivity, a_i^-, the new value of a_i is drawn from the distribution $G(a_i, a_i^-)$ where this distribution is decreasing in a_i^-. Since the value of a_i^- will be lower on average for the non-employed than for the self-employed, typically we would expect $\psi_2 \leq 1$. Although $\psi_2 < 1$ in the data, in what follows, we consider $\psi_2 = 1$ since it provides a potential justification for dropping the dependence on

[5] Note that the non-overlapping property is sufficient for this but clearly far from necessary since it implies that every informal employer will be less or equally likely to accept a formal sector job as opposed to on average.

[6] Without it a worker with an existing relatively high a_i might transition from U to T due to a drop in b_i. Such a worker cannot exist if the non-overlapping property holds.

a_i^- in the distributions and as such simplifies the model solving procedure. Hence, we can write $G(a, a^-) \equiv G(a)$ and equivalently $g(a, a^-) \equiv g(a)$.[7]

[7] Ideally, gross outflow from informality to non-employment should be negligible compared to gross outflow from informality to all states of the market for the non-overlapping property to hold. Although it is apparently not the case as shown in Figure C4 of Appendix C, given that the overall relative gross outflow (top left panel) is about 34% and not the lion's share, we argue that the non-overlapping (though not perfectly) still holds. Note that relative gross outflow from informality seems to vary depending on the type of informal job, for instance, the largest is from self-employment (bottom left panel), closely followed by informal salaried (top right panel) whilst the least is from informal employer (bottom right panel) at 40%, 34% and 10% respectively.

4.4.5 Income in the non-formal states

Given $\phi = 1$, we assume that an individual will choose non-formal state $(U, Z, S \; or \; T)$ so as to maximise her current income. Let,

$$f(a_i, b_i, w_I) = \max \begin{cases} b_i \\ w_I \\ p_I a_i \\ \max\limits_{L} [p_I(1+L)^{\zeta} - w_I L] \end{cases} \tag{9}$$

Note that since the expressions on the R.H.S of $f(.)$ are continuous in the arguments of $f(.)$, then so is $f(.)$. Table C3 outlines the possible conditions for choosing each of the non-formal states.

Table C3: Non-formal states.

Condition	Value of $f(a_i, b_i, w_i)$	State
$p_I a_i < w_I \;\&\; b_i < w_I$	w_I	Informal salaried (Z)
$w_I \leq p_I a_i < \frac{w_I}{\zeta} \;\&\; b_i < p_I a_i$	$p_I a_i$	Self-employment (S)
$\frac{w_I}{\zeta} \leq p_I a_i \;\&\; b_i < \eta(a_i, w_I)$	$\eta(a_i, w_I)$	Informal employer (T)
None of the above	b_i	Non-employment (U)

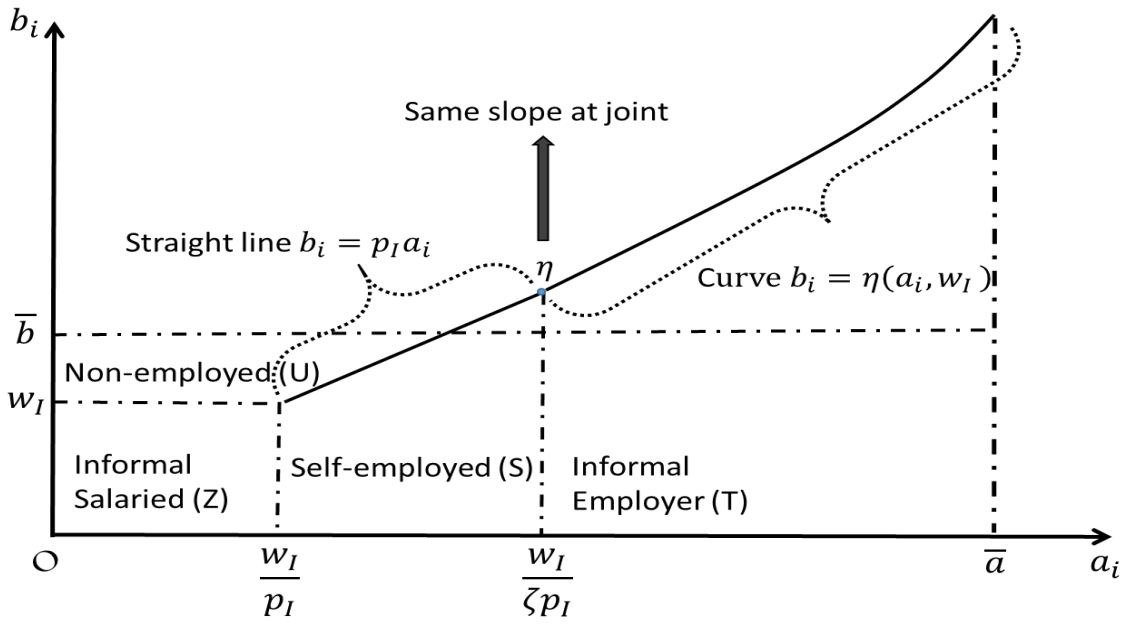
where $\eta(a_i w_I) = \left[\frac{1-\zeta}{\zeta}\left(\frac{\zeta p_I a_i}{w_I}\right)^{\frac{1}{1-\zeta}} + 1\right] w_I$ is the profit made by an informal employer when choosing L optimally, with the optimal choice, $L^*(a_i, w_I)$ being

$$L^*(a_i, w_I) = \left(\frac{\zeta p_I a_i}{w_I}\right)^{\frac{1}{1-\zeta}} - 1 \tag{10}$$

To be an informal employer, she must choose $L \geq 0$ and she will only do so when $\zeta p_I a_i \geq w_I$. Figure C5 below illustrates the non-overlapping property discussed in Section 4.4.4 as

well as the border conditions based on which individuals choose their respective non-formal state.

Figure C5: Non-overlapping property.



There are a few important things to note from the figure. First, an informal employer will not transition to non-employment given the gap in the respective state income. The maximum income earned by an individual in non-employment is $\overline{b}$ whilst the maximum income for an informal employer is $\eta(a_i, w_I)$. It is obvious that the latter is greater than the former, i.e. $\eta(a_i, w_I) > \overline{b}$ and on moving to non-employment, informal employer has to forgo income equivalent to $b_i = \eta(a_i, w_I)$. This is the non-overlapping property. Second, an individual will only become self-employed as long as their threshold ability is between $\frac{w_I}{p_I}$ and $\frac{w_I}{\zeta p_I}$. Third, labour demand, L^D is obtained by integrating the area corresponding to informal employer and labour supply, L^S is obtained by integrating the area corresponding to informal salaried.

Now, let us collate all the non-formal states and denote this together as $N = \{U \cup Z \cup S \cup T\}$ and write down $N(a_i, b_i)$ for the corresponding value function and also $\gamma_N = \gamma_U + \gamma_Z + \gamma_S + \gamma_T$. The informal sector wage w_I is therefore obtained by equating labour demand and labour supply for informal salaried. Consider the distribution of a_i and b_i across the non-formal states and let the density be $\mu(a_i, b_i)$. In general, this is endogenous and will be challenging (though not necessarily impossible) to work out. Our labour demand, L^D from the model is given by

$$L^D = \int_{\frac{w_I}{\zeta p_I}}^{\overline{a}} \int_0^{\eta(a,w_I)} \left[\left(\frac{\zeta p_I a}{w_I} \right)^{\frac{1}{1-\zeta}} - 1 \right] \mu(a,b) db da \tag{11}$$

4.4.6 Bellman equations

Assuming the simplifications described above, the steady state Bellman equations can be written as follows.

Value of non-formal activity to a worker:

$$rN(a_i, b_i) = f(a_i, b_i, w_I) + m(\theta)[W(\xi^0, a_i, b_i) - N(a_i, b_i)] \quad (12)$$

$$+\lambda_a \left[\int N(a, b_i) g(a) da - N(a_i, b_i)\right] + \lambda_b \left[\int N(a_i, b) g_b(b) db - N(a_i, b_i)\right]$$

Value of a formal sector job to a worker:

$$rW(a_i, b_i, \xi) = w_F(a_i, b_i) + \lambda_\xi \int max[W(\xi, a_i, b_i), N(a_i, b_i)] f(\xi)\, d\xi \quad (13)$$

$$+\delta[N(a_i, b_i) - W(a_i, b_i, \xi)]$$

Value of a filled job by a (a_i, b_i) worker to a firm in the formal sector:

$$rJ(a_i, b_i, \xi) = p^F - (1 + \Omega) w_F(a_i, b_i) + \lambda_\xi \int max[J(\xi, a_i, b_i), V] f(\xi)\, d\xi \quad (14)$$

$$+\delta[V - J(a_i, b_i, \xi)]$$

where p^F is the value of output produced from an occupied formal job and Ω is the payroll tax rate[8].

[8] Payroll tax affects the profitability of firms which is translated into lower demand for workers and as such less vacancies are created. Hence, labour market tightness falls and unemployment rises (Mortensen, 2005).

Value of a vacancy to a firm with a posting cost – c:

$$rV = -c + \frac{m(\theta)}{\theta}\int_0^{\overline{a}}\int_0^{\overline{b}} J(a_i, b_i)\mu(a_i, b_i)dbda \equiv -c + \frac{m(\theta)}{\theta}\bar{J} \tag{15}$$

where we use the bar notation to denote integration with respect to a_i and b_i over the density $\mu(a_i, b_i)$.

Free entry condition implying that firms post new vacancies until the present discounted value is driven to zero:

$$V = 0 \tag{16}$$

Wage is determined through a Nash bargaining process where β is the bargaining power of workers in the wage negotiation:

$$J(a_i, b_i) = \frac{(1+\Omega)(1-\beta)}{\beta}[W(a_i, b_i) - N(a_i, b_i)] \tag{17}$$

Note that the existence of payroll tax reduces the match surplus and as such both firms and workers may be willing to set lower wages to avoid paying more tax. Since, "formal sector jobs are always the best", the transition rate from any non-formal state to formal sector job is always $m(\theta)$. However, because of endogenous job destruction, the transition rate from formal sector job to non-formal states will depend on (a_i, b_i) and so in general, we would expect $\mu(a_i, b_i) \neq g_a(a_i)g_b(b_i)$ if endogenous. However, without endogenous job destruction there is no dependence on (a_i, b_i) and we can show that

$\mu(a_i, b_i) = g_a(a_i)g_b(b_i)$, so it is exogenously given. This simplifies the model equations radically.

4.4.7 Model equations without endogenous job destruction

We now re-write the steady state Bellman equations by averaging them over a_i and b_i as follows.

Value of non-formal activity to a worker:

$$r\overline{N} = \overline{f}(w_I) + m(\theta)\left[\overline{W} - \overline{N}\right] \tag{18}$$

Value of a formal sector job to a worker:

$$r\overline{W} = \overline{w}_F + \delta\left[\overline{N} - \overline{W}\right] \tag{19}$$

Value of a filled job by a (a_i, b_i) worker to a firm in the formal sector:

$$r\bar{J} = p^F - (1+\Omega)\overline{w}_F + \delta\left[V - \bar{J}\right] \tag{20}$$

Value of a vacancy to a firm with a posting cost – c:

$$rV = -c + \frac{m(\theta)}{\theta}\bar{J} \tag{21}$$

Free-entry condition, as before:

$$V = 0 \tag{22}$$

Wage-bargaining process:

$$\bar{J} = \frac{(1+\Omega)(1-\beta)}{\beta}\left(\overline{W} - \overline{N}\right) \tag{23}$$

Job-market dynamics given by the difference between separation and matching flow:

$$\dot{\gamma}_N = \delta(1-\gamma_N) - m(\theta)\gamma_N \tag{24}$$

Finally, labour demand, L^D from equation (11) can be re-written as:

$$\int_0^{\frac{w_I}{p_I}} \int_0^{w_I} g(a)g(b)dbda = \int_{\frac{w_I}{\zeta p_I}}^{\overline{a}} \int_0^{\eta(a,w_I)} \left[\left(\frac{\zeta p_I a}{w_I} \right)^{\frac{1}{1-\zeta}} - 1 \right] g(a)g(b)dbda \tag{25}$$

where the expressions on the L.H.S and R.H.S represents labour supply and labour demand respectively.

If for instance, a and b are uniformly distributed on $[0, \overline{a}]$ and $\left[0, \overline{b}\right]$ respectively and $\overline{b}$ is such that the non-overlapping property is satisfied, then

$$\eta\left(\frac{w_I}{\zeta p_I}, w_I\right) \geq \overline{b} \Leftrightarrow \zeta\overline{b} \leq w_I \tag{26}$$

Since $\eta(.,.)$ is the profit flow of informal employers and $\frac{w_I}{\zeta p_I}$ is the threshold ability for becoming self-employed, it implies that all informal employers are better off than all non-employed individuals. Given this,

$$\int_0^{\frac{w_I}{p_I}} \int_0^{w_I} g(a)g(b)dbda = \frac{(w_I)^2}{\overline{a}\overline{b}p_I} = \frac{1}{\overline{a}} \int_{\frac{w_I}{\zeta p_I}}^{\overline{a}} \left[\left(\frac{\zeta p_I a}{w_I} \right)^{\frac{1}{1-\zeta}} - 1 \right] da$$

$$\Rightarrow \frac{(w_I)^2}{\overline{a}\overline{b}p_I} = \left[\frac{1-\zeta}{2-\zeta} \left(\frac{\zeta p_I \overline{a}}{w_I} \right)^{\frac{1}{1-\zeta}} - 1 \right] + \frac{w_I}{\zeta(2-\zeta)p_I\overline{a}} \tag{27}$$

The non-overlapping condition from equation (26) will hold if

$$\zeta^2 - \frac{1}{2-\zeta} \leq \kappa\left[\frac{1-\zeta}{2-\zeta}\kappa^{\frac{1}{1-\zeta}} - 1\right] \tag{28}$$

where $\kappa = \frac{\overline{a}p_I}{\overline{b}}$. Note that this will always work as long as $\kappa \geq 2$ or $\kappa > 1$ and ζ is sufficiently close to 1.

We can now use equation (27) to obtain w_I which in turn allows us to solve for $\overline{f}(w_I)$ in equation (18) using Table C3 as follows.

$$\overline{f}(w_I) = \frac{1}{\overline{a}\overline{b}}\left[\int_0^{\frac{w_I}{p_I}} (w_I)^2 da + \int_0^{\frac{w_I}{p_I}} \frac{\overline{b} + w_I}{2}\left(\overline{b} - w_I\right) da\right] \tag{29}$$

$$+\frac{1}{\overline{a}\overline{b}}\left[\int_{\frac{w_I}{p_I}}^{\frac{\overline{b}}{p_I}} (p_I a)^2 da + \int_{\frac{w_I}{p_I}}^{\frac{\overline{b}}{p_I}} \frac{b + p_I a}{2}(b - p_I a) da\right]$$

$$+\frac{1}{\overline{a}}\left[\int_{\frac{\overline{b}}{p_I}}^{\frac{w_I}{\zeta p_I}} (p_I a) da + \int_{\frac{w_I}{\zeta p_I}}^{\overline{a}} \eta(a, w_I) da\right]$$

$$= \frac{(w_I)^3}{3p_I\overline{a}\overline{b}} + \frac{\left(\overline{b}\right)^2}{6p_I\overline{a}} - \frac{(w_I)^2}{2\zeta p_I\overline{a}(2-\zeta)} + w_I\left[1 + \frac{(1-\zeta)^2}{\zeta(2-\zeta)}\left(\frac{\zeta p_I\overline{a}}{w_I}\right)^{\frac{1}{1-\zeta}}\right] \tag{30}$$

In this model without endogenous job destruction, the transition rate from formal sector employment to non-formal states is always δ and from non-formal states to formal sector job is always $m(\theta)$. The transition rates within non-formal states are computed using Table C3.

Now, let $\mu(X)$ denote the number of workers in state X as a proportion of the total number of workers in the non-formal states i.e. $\mu(U) + \mu(Z) + \mu(S) + \mu(T) = 1$. Therefore, using Figure C5, we can compute the following quantities assuming a and b are uniformly distributed as above.

$$\mu(U) = \frac{\left(\overline{b}\right)^2 - (w_I)^2}{2p_I\overline{a}\overline{b}} \tag{31}$$

$$\mu(Z) = \frac{(w_I)^2}{p_I\overline{a}\overline{b}} \tag{32}$$

$$\mu(T) = 1 - \frac{w_I}{\zeta p_I\overline{a}} \tag{33}$$

Also, consider that $\tau(X, Y)$ is the transition rate from state X to state Y. This gives us 6 parameters to calibrate, namely, $p_I, \zeta, \overline{a}, \overline{b}, \lambda_a$ and λ_b. However, we could potentially introduce 2 more $\underline{a}$ and $\underline{b}$ if for instance, we assume that a_i is uniformly distributed on $\left[\underline{a}, \overline{a}\right]$ rather than $[0, \overline{a}]$. Furthermore, we potentially have 10 targets as shown below.

Transition rates in and out of informal salaried (Z):

$$\tau(U, Z) = \lambda_a\left[\frac{2(w_I)^2}{\overline{a}\left(\overline{b} + w_I\right)}\right] \tag{34}$$

$$\tau(Z, U) = \lambda_a\left(1 - \frac{w_I}{\overline{b}}\right) \tag{35}$$

$$\tau(Z, S) = \lambda_a\left[\frac{(1-\zeta)w_I}{\zeta p_I\overline{a}}\right] \tag{36}$$

Transition rates in and out of informal employer (T):

$$\tau(U,T) = \tau(Z,T) = \tau(S,T) = \lambda_a\left(1 - \frac{w_I}{\zeta p_I \overline{a}}\right) \tag{37}$$

$$\tau(T,U) = \lambda_a\left[\frac{\left(\overline{b}\right)^2 - (w_I)^2}{2p_I\overline{a}\overline{b}}\right] \tag{38}$$

$$\tau(T,Z) = \lambda_a\left[\frac{(w_I)^2}{p_I\overline{a}\overline{b}}\right] \tag{39}$$

Note that for instance, $\tau(T,S)$ and $\tau(S,Z)$ are pinned down by the above conditions as a result of being in steady state. Then, the final free transition rate is,

$$\tau(U,S) = \frac{1}{\overline{a}\overline{b}\mu(U)}\left[\lambda_a\int_{w_I}^{\overline{b}}\frac{b}{(p_I)^2\overline{a}}\left(\frac{w_I}{\zeta} - b\right)db + \lambda_b\int_{\frac{w_I}{p_I}}^{\frac{b}{p_I}}\frac{p_I a}{\overline{b}}\left(1 - \frac{p_I a}{\overline{b}}\right)da\right] \tag{40}$$

which pins down $\tau(S,U)$ as well.

Poisson arrival rate to a_i and b_i:

$$\lambda_a = \frac{\tau(T,Z)}{\mu(Z)} \tag{41}$$

$$\lambda_b = \frac{\tau(Z,U)}{1 - \sqrt{\frac{\mu(Z)}{2\mu(U) + \mu(Z)}}} \tag{42}$$

This in turn gives us the elasticity of L^D, informal sector productivity and ratio of maximum non-employment income to maximum productivity in self-employment respectively.

$$\zeta = 1 - \frac{\tau(Z,S)}{\lambda_a - \tau(U,T)} \tag{43}$$

$$p_I = \frac{\tau(U,Z)}{2\tau(T,Z)}\left[1 + \sqrt{\frac{\mu(Z)}{2\mu(U) + \mu(Z)}}\right] \tag{44}$$

$$\frac{\overline{b}}{\overline{a}} = p_I\sqrt{\mu(Z) * [2\mu(U) + \mu(Z)]} \tag{45}$$

4.5.1 Calibration

Having explained the steady state of the model, our goal is to test out its performance. The procedure involves considering a subset of the parameters to be fixed based on estimates or assumptions from other studies in the literature whilst the remaining parameters are calibrated in order to match the recent empirical evidence from Brazil between 2002 and 2015. Table C4 of Appendix C summarizes the structural parameters of the model based on a quarterly calibration.

We only have annual real interest rate, r which is 0.3521 on average obtained from the World Bank database of World development indicators. Hence, quarterly rate is computed as $\frac{0.3521}{4} = 0.088$. The matching function is assumed to be Cobb-Douglas, $m = mu^{\eta}v^{1-\eta}$ where the elasticity of searching, η is set to be 0.5 which is the lower bound of the estimates from Petrongolo & Pissarides (2001). As standard in the literature, the bargaining power of workers in formal sector jobs is fixed at 0.5 which features a systematic Nash bargaining solution. This implies that the Hosios (1990) condition[9] holds in our calibration. The job posting parameter, c is calibrated to ensure a labour market tightness, θ of 1. Bosch & Esteban-Pretel (2012) assert that there are no estimates of the value of the market tightness in Brazil or any other comparable economy due to the lack of data on vacancies. Shimer (2005) emphasises that the steady state value of θ adds little value to the results since varying it only implies a re-adjustment of the matching efficiency parameter, leaving everything else unchanged. We assume and normalise the price of formal sector production to 1.

[9] It is when the relative bargaining power to workers in wage negotiation coincides with the elasticity of search in job matches.

The matching efficiency parameter, m is calibrated to hit the average transition rate from overall non-formal states to formal sector employment. Given that PME-Nova records data on a monthly basis, we apply the technique discussed in Section 4.3.1 to compute the weekly transition rates which are multiplied by 12 (i.e. 4 weeks in a month and 3 months in a quarter) to obtain the corrected seasonally adjusted quarterly transition rates (Silva, & Vázquez-Grenno, 2013). Thereafter, a weighted average is taken of all probabilities associated to the transitions from overall non-formal states to formal sector employment giving us 8.84%. The transition rate from formal sector employment to overall non-formal states, δ is consistent with the data average of 24.81% computed from the application of the aforementioned procedures except that instead a weighted average, we sum all the probabilities that capture the transition from formal sector employment to overall non-formal states. The idea is to ensure that in equilibrium the overall flow from formal sector employment to non-formal states and vice versa is equal.

The Poisson arrival rate of shock to individual opportunities or abilities, λ_a and non-employment income, λ_b are computed from PME-Nova data using equations (41) and (42) of the model. Similarly, the elasticity of labour demand in the informal sector, ζ, informal sector productivity, p_I and ratio of maximum non-employment income to maximum productivity in self-employment, $\frac{\overline{b}}{\overline{a}}$ are acquired from PME-Nova data using equations (43), (44) and (45) of the model. Finally, we set the payroll tax rate, Ω at 7.5% obtained from the Secretariat of the Federal Revenue Brazil in our calibration. This is the lowest band of the progressive tax system employed in Brazil where taxes are levied at 7.5%, 15%, 22.5% and 27.5% respectively depending on an individual's salary.

Note that these labour market indicators are computed taking into account the population definition used in the present model so that the total labour force is equal to the sum of non-employed, formal sector workers and informal sector workers which encompasses the informal salaried, self-employment and informal employer. The formal sector is worked out as the share of formal workers over this restricted population and the same applies to all other categories.

4.5.2 Simulation results

Based on the above specifications, in what follows, we conduct an experiment to observe how our search and matching model responds to a policy reform where the payroll tax rate is increased step-by-step from the lowest band of 7.5% to the highest band of 27.5%. In particular, our interest is on the reaction of the labour market tightness, wage gap differential, willingness of workers to leave non-formal states and availability of formal sector jobs. Table C5 of Appendix C reports the simulation results implied by the calibration.

First and foremost, note that the labour market tightness, θ which in our case is the ratio between vacancies and overall non-formal states is about 1 for the baseline economy which is consistent with the proposed calibration of the job costing parameter, c. As payroll tax rate, Ω is increased, it is found that our model is successful in replicating many of the aspects of the search and matching theory. To be specific, we observe that θ declines by almost 12%, 22% and 28% as we move up the tax band respectively. This implies that the economy transforms into an employer's market where there may be a large pool of potential and available workers but not enough formal sector jobs. Similarly, we observe that the transition rate from non-formal states to formal sector employment, m has fallen by about 6%, 12% and 15% whilst the duration spent in non-formal states, du has gone up by approximately 7%, 13% and 18% for increases in Ω. Given that both firms' incentive to open vacancies and workers' incentive to search for formal sector jobs are adversely affected, in all likelihood, not only non-employment but also the size of informal sector will increase.

In terms of the wages, our model seems to suggest that moving up the tax band also increases inequality by almost 4%, 9% and 11% respectively between the formal and informal sector workers. Specifically, formal sector wage, w_F is going up in line with government transfers, G which we argue may boost industrial activity and in turn cause a productivity shock. This is consistent with Jiang (2014) who proclaims that such effect on w_F may happen if the productivity gain outweighs the cost arising from the tax rise. Given the increase in w_F, from a worker's perspective, the value of a non-formal activity, $\overline{N}$ diminishes by approximately 0.9%, 1.7% and 2.2% whilst the value of formal sector job, $\overline{W}$ improves by about 0.7%, 1.5% and 1.9% respectively. Conversely, from a firm's perspective, the value of a vacancy, $\overline{V}$ remains constant whilst the value of a filled formal sector job, $\bar{J}$ increases by almost 14%, 29% and 38% respectively. Therefore, we witness that the job market dynamics, γ_N which shows the difference between the separation and matching flow is gradually increasing by approximately 1.9%, 3.5% and 4.4% respectively. However, higher wage dampens expected profits of firms and as such fewer vacancies are opened in line with declining θ despite the positive effects on profits from labour productivity growth.

Notice that informal sector wage, w_I and distribution of ability across non-formal workers, $\overline{f}(w_I)$ remains unaffected from the changes in Ω which is in line with Botero et al. (2004) who similarly doesn't observe any statistically notable effect on informality. Ulyssea (2010) accentuates that an increase or decrease in Ω only has a limited impact on wage irrespective of the sector and as such the wage gap is often negligible which runs against our findings presented here. However, it may not be too concerning since results in the empirical literature regarding the influence of payroll taxes on wages and

employment are mixed (Kugler & Kugler, 2009). Last but not the least, it is worth noting the non-overlapping condition holds across the tax band given that κ is consistently greater than 1 and ζ is sufficiently close to 1.

4.6 Conclusion

In this paper, we present a set of stylized facts regarding gross flows and transition rates of workers from Brazil using the new Monthly Employment Survey (PME-Nova) from 2nd quarter of 2002 till 4th quarter of 2015. For the purpose, a 5-state model is derived where we overtly account for different tiers of informal job given how informality has been referred to in literature as an unregulated micro-entrepreneurial sector (Maloney, 2004; Mondragón-Vélez & Peña, 2010). Our findings suggest that approximately 27% of the gross flows between employment and non-employment involve a formal sector job. The rest of the jobs are informal shared among informal salaried (40%), self-employment (31%) and informal employer (2%) respectively. What's more, the lion's share of the flows towards formal sector jobs come from informal salaried which may be due to the fact that for the majority of Brazilian firms who already employ a large number of informal workers, it is rather time-saving and cost-effective to retain the existing workforce through contract conversion as and when required instead of going about advertising, screening and eventually recruiting a fresh worker from non-employment.

Looking at the evolution of the key labour market indicators, we observe that the overall fall in the aggregate non-employment rate at least till the end of 2012 is largely due to the number of workers being hired in the formal sector and an overall fall in the number of separations. This is consistent with the concept of increased formalization in the 21st century Brazil put forward by Berg (2011). However, the country faced continuous macroeconomic challenges ever since which significantly lowered growth, accelerated inflation and adversely affected the overall employment rate. In terms of the informal sector jobs we come across two interesting findings. First, it seems that the informal

salaried has suffered most during the Global recession of 2008-09. Considering that core workers in the Brazilian firms are formally employed whilst those who are less essential are handled informally, the drastic fall during recessionary periods maybe the result of them being laid off. Second, there has been a sharp rise in self-employment which may be a consequence of individuals dropping out of the manufacturing sector which was worst hit by the exchange rate overvaluation and profit squeeze (Oreiro & D'Agostini, 2016) and choosing the next best alternative.

In terms of the transition rates, we perceive that in general those from informal sector jobs to non-employment are substantially larger when compared to the ones from formal sector jobs. This may be explained by the country's social beliefs and strict labour laws which fuelled the high turnover rate as well as the government established welfare programs aimed to alleviate poverty, eliminate child labour and develop better human capital. Conversely, the transition rates in reverse, i.e. from non-employment to the different types of job follow a similar pattern but with much lower magnitudes. In a boarder sense, it is consistent with the findings of Bosch & Esteban-Pretel (2012) who argue that the transition rates associated to job destruction dominates the dynamics of the Brazilian labour market and therefore are the key to understanding the cyclical fluctuations. With regards to the job-to-job transitions, we observe that many of the important probabilities are related to informal salaried, self-employment and formal sector jobs. However, the largest is from informal employer to self-employment.

Based on the presented empirical evidence, we build a search and matching model where the formal sector is characterized by search frictions whilst the informal sector is frictionless and perfectly competitive. To expand on the existing literature, we

incorporate 3 key features to the model. First, we allow for the coexistence of formal and informal jobs in the labour market where workers decide between being formal or informal. It is assumed that firms post generic vacancies and when the worker arrives, they decide on establishing employment relationship based on the quality of the match. Second, given the importance of gross flows and transition rates within the informal sector, we allow for workers to sort themselves into different tiers of informal job based on individual opportunities or abilities. Zenou (2008) emphasises on the importance of self-employed and informal employers who start business by recruiting friends and relatives through the word-of-mouth communication in informal sector but never truly models these features explicitly. Third, we introduce the "non-overlapping property" which captures the idea that an informal employer will not move to non-employment given that her income is greater than the maximum as a non-employed.

Finally, we calibrate and simulate the model to assess its success in accounting for the empirical facts. To be exact, we conduct an experiment to observe how our model responds relative to the search and matching theory when there is a policy reform such as a change in the payroll tax rate. Among other things, it is found that a rise in the tax rate aggravates an economy's labour market tightness given that tax reduces profits and therefore acts as a deterrent for firms to open more vacancies. This is accompanied by a fall in the search intensity as well as willingness of workers to leave non-formal states. Put together, we argue that tax plays an integral role in increasing both non-employment and the size of informality. Looking at the wages, our model predicts that tax worsens inequality between the formal and informal sector workers. This may be particularly true, if government transfers are tied to the tax rate and specifically targeted to boost industry activity causing a productivity shock. In the end, formal sector wage will increase if the

productivity gain outweighs the cost arising from the tax rise (Jiang, 2014). Although higher wage may incentivise non-formal workers to search for formal sector jobs, matches will still be rare considering that fewer vacancies are opened due to the rising wage cost. Note that informal sector wage is completely unaffected by changes in the payroll tax rate which is consistent with Botero et al. (2004).

To wrap it up, our research has been an incredible journey to say the least. From an empirical perspective, we have revealed recent dynamics in the Brazilian labour market – a country with notable informality using PME-Nova. From a theoretical perspective, we have built a 2-sector model within a search and matching framework considering different tiers of informal job such as informal salaried, self-employment and informal employer. Neither has been done before due to the extent of information required and complexities involved. Therefore, it is our humble attempt to expand upon the search and matching literature on developing countries. Unfortunately, this also means that we don't have similar work to compare our findings and as such the main limitation of the study. Nevertheless, our model is a stepping stone for future researchers who are interested in exploring such labour markets of developing countries where the formal sector is characterized by search friction whilst the informal sector is competitive with different tiers of informal job.

Chapter 5

General conclusion and limitations

5.1 General conclusion

In this research project, we have derived models and conducted empirical analyses to shed some light on various aspects that past researchers have been debating on. Initially, we set ourselves with a few questions and one by one tried to solve them to accomplish our goal. In the following we summarise the main conclusions from each chapter.

In Chapter 2, we attempt to evaluate the importance of FDI as a driving force in the growth of developing counties over the period 1980 to 2012. More importantly, our interest is on a comparative study to explain the growth disparity between BRICs and non-BRICs based on the neoclassical growth theory. To achieve our goal, we construct an augmented Solow model and apply different estimation methodologies such as correlated random effects and feasible least square where in each step we add a growth determinant and observe the impact of FDI on growth.

Our results across different models and estimation methodologies are robust and unanimously supports the universal view that after controlling for other factors, FDI affects growth positively in the developing countries where on average a 1% increase accounts for 0.014% increase in per capita GDP. However, FDI on its own cannot influence economic growth which is consistent with Carkovic & Levine (2005). What's more, FDI has been more efficacious in BRICs compared to the developing economies in the sample and as such led to the disparity in per capita GDP equivalent to 0.064%. Thus, we provide

empirical support to the premise by Wilson & Purushothaman (2003) and Cheng et al. (2007) that BRICs over time may have attracted quality FDI.

In terms of the other growth determinants, we perceive that GDI, education index and telephone lines per capita affect growth positively where the contribution to per capita GDP is 0.109%, 0.022% and 0.011% for every 1% increase in those respective regressors. However, only GDI and education index seems to play integral roles in the growth discrepancy. Specifically, the former has been far more effective in BRICs leading to the disparity in per capita GDP equivalent to 0.472% whilst the latter has been detrimental in BRICs leading to the disparity in per capita GDP equivalent to 0.005%. Moreover, there are other structural differences between these groups of countries as accentuated by the highly significant and positive country dummy. Judging from the magnitude and level of significance of the coefficients, we conclude that GDI is the most potent growth determinant in the developing countries, followed by FDI, human capital and infrastructure respectively.

In Chapter 3, we seek to elucidate the dynamics of the Brazilian labour market over the period 2002 to 2014. Given the information on contracts in the new Monthly Employment Survey (PME-Nova), we set-up a 6-state model explicitly considering employment quadrility (i.e. employment: formal temporary, formal permanent, informal temporary and informal permanent). To accomplish our goal, we conduct a flow analysis focusing on the gross flows, evaluate business cycle properties of the transition rates and represent contribution of those transition rates to fluctuations in the aggregate unemployment rate.

All our results point to a broadly similar conclusion i.e. the employment quadrility is crucial towards understanding the unemployment volatility particularly in developing countries and in our scenario the functioning of the Brazilian labour market. Specifically, we perceive that about 53% of the gross flows between employment and unemployment involve permanent contracts and it is more pronounced in the formal sector (55%). Temporary contracts make up the rest and enjoy the lion's share of employment in the informal sector (94%). Moreover, inactivity constitutes approximately 44% of the working-age population where ins and outs significantly outpace that of unemployment similar to the Japanese labour market (Lin & Miyamoto, 2012). This implies that the stock of inactive workers is an important source of labour supply for the economy and therefore crucial for explaining labour market activities in Brazil.

On the evolution in the ins and outs of unemployment, our study uncovers that decrease in the aggregate unemployment rate is largely due to increase in the number of workers being hired predominantly in the formal sector and an overall fall in the number of separations, consistent with the concept of increased formalization in the 21st century Brazil. With regards to the transition rates, counter-cyclical behaviour is detected generally from employment to unemployment and it is more pronounced in the share of temporary jobs which implies that the part-timers are often the first to be laid-off when economy is not performing well. Although this outcome is true for the formal sector, spikes during the recessions indicate that workers suffer equally irrespective of the contract type in the informal sector.

We perceive that movements in the transition rate from unemployment to employment and employment to unemployment roughly explains about 1% and 42% of all the

fluctuations in the aggregate unemployment rate respectively, verifying that job separation rate plays a more dominant role in accounting for the country's unemployment rate volatility similar to findings from the US. Furthermore, more than 60% of the unemployment volatility are explained by movements between unemployment and employment involving transition rates to and from permanent jobs.

In Chapter 4, we try to take a closer look at the dualistic nature of labour market in the developing countries where there are different tiers of informal job such as informal salaried, self-employed and informal employer. To accomplish our goal, we develop a search and matching model with 5-states where the formal sector is characterised by search friction whilst the informal sector is frictionless and perfectly competitive, conduct model calibration using data from Brazil over the period 2002 to 2015 and perform a policy simulation such as a tax reform.

Our empirical results indicate that about 27% of the gross flows between employment and non-employment involve a formal sector job. The rest of the jobs are informal shared among informal salaried (40%), self-employment (31%) and informal employer (2%) respectively. Looking at the evolution of key labour market indicators, we notice that the overall fall in the aggregate non-employment rate at least till the end of 2012 is largely due to the number of workers being hired in the formal sector and an overall fall in the number of separations in line with Berg (2011). However, the country experienced continuous macroeconomic crisis ever since which significantly lowered growth, accelerated inflation and adversely affected overall employment rate.

For informal sector jobs, separation rate has been notably larger for informal salaried, particularly over the downturns and Global recession of 2008-09 whilst recently, job

finding rate has picked up for self-employment. In terms of the transition rates, the general consensus is that those from informal sector jobs to non-employment and vice versa are significantly larger than the ones related to formal sector employment. Also, despite the fact that many of the important job-to-job transitions occur between sectors, we observe that the largest is from informal employer to self-employment.

Given that our theoretical model provides a framework for studying the effects of policy changes in the developing countries, we examine the impact from a tax policy reform. We show that such government intervention affects labour market outcomes by changing the incentive of both firms to create vacancies and workers to search for formal sector jobs. In particular, it is perceived that a rise in payroll tax rate aggravates labour market tightness by reducing firms' profits which deter them from opening more vacancies. This is accompanied by a fall in search intensity and willingness of workers to leave non-formal states. Therefore, put together, tax increases both non-employment and the size of informality.

Our model also predicts that an increase in the tax rate worsens inequality between the formal and informal sector workers. This may be particularly true, if government transfers are tied to the tax rate and specifically targeted to boost industry activity leading to a productivity shock. In the end, formal sector wage will increase as long as the productivity gain outweighs the cost associated to the tax rise. Although higher wage may attract non-formal sector workers, matches will still be rare provided that fewer vacancies are opened due to the rising wage cost. Note that informal sector wage has been found to be completely unaffected by changes in payroll tax rate in line with Botero et al (2004).

5.2 Limitations

No studies can be perfect and there is always scope for improvement. Therefore, in the following, we discuss the limitations from each chapter.

In Chapter 2, while we reveal the impact of FDI on growth through CRE and FGLS estimates, it only gives us the average and not individual effect on growth. Hence, country-specific studies may be more ideal to ascertain the relevant determinants in a country's growth. Also, our investigation only considers 6 macroeconomic factors that we deem to be most influential based on the neoclassical theory of economic growth in an attempt to robustly conclude. However, the positive sign and significance of the country dummy seems to indicate that there are other structural differences that we haven't considered have contributed to the growth disparity. Thus, it could be of interest for future scholars to improve on our results by exploring other growth determinants such as government consumption, inflation, taxation, black market premium, etc. Alternatively, the sample size and/or time period may be altered, different theories of growth may be adopted such as endogenous or Schumpeterian complemented by estimation techniques including seemingly unrelated regression (SUR) and dynamic panel models (since FDI is often proposed to have a positive lagged effect) to discern whether the limitations of our model choice has biased any of the findings.

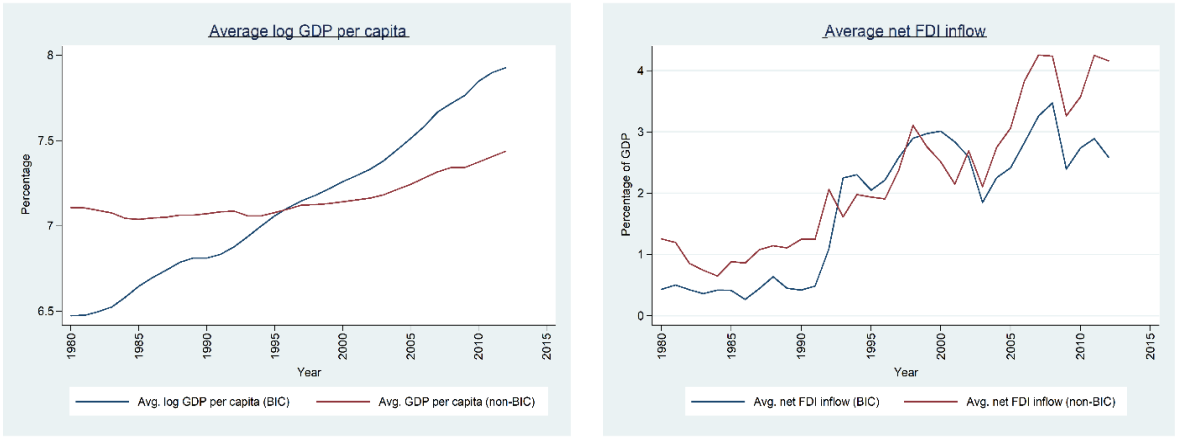
In Chapter 3, while we disclose how gross flows and transition rates in general between different market states explain the evolution of the aggregate unemployment rate, focusing on a developing country like Brazil, it is the first paper of its kind to carry out such a flow analysis and implement a 6-state model to resemble developing labour markets accounting for temporary and permanent work in both formal and informal

sector. Furthermore, Bosch & Esteban-Pretel (2012) highlight that the drastic modification of the PME in 2002, particularly in the adopted methodology has made it impossible to reconcile the new and old definition of unemployment. Hence, we neither could directly compare our results with the previous studies on Brazil nor with similar studies on other countries. Nevertheless, our findings will be useful for future researchers as stylised facts who seek to evaluate unemployment rate volatility in similar labour markets of developing countries.

In Chapter 4, while we explore the dualistic nature of labour market in developing countries, conduct model calibration and perform policy simulation within a search and matching framework by taking into consideration 5 states, namely, non-employment, formal sector employment, informal salaried, self-employment and informal employer respectively, it is something that has never been done before due to the extent of information required and complexities involved. Unfortunately, this also means that we don't have similar work to compare our findings and as such the main limitation of the study. Nevertheless, our model is a stepping stone for future researchers who are interested in exploring such labour markets of developing countries where the formal sector is characterized by search friction whilst the informal sector is competitive with different tiers of informal job.

Appendix A

Figure A1: Evolution of average log GDP per capita and net FDI inflow – BIC Vs. non-BIC



Note: Own elaboration based on World Bank & OECD National Accounts database.

Figure A2: Evolution of average log GDP per capita and net FDI inflow – BRIC Vs. non-BRIC

Note: Own elaboration based on World Bank & OECD National Accounts.

Table A1: List of empirical studies with key features

Impact of FDI on economic growth		
Study	**Effect**	**Comment**
Adams (2009)	Positive/negative	Conditional on the synergies between FDI and domestic investment
Aitken & Harrison (1999)	Ambiguous	No evidence
Alfaro (2003)	Positive/negative/ambiguous	Conditional on the sector of investment: Primary, manufacturing or service
Alfaro et al. (2004)	Positive	Conditional on the development of financial market
Balasubramanyam et al. (1996)	Positive	Conditional on the trade policy regime: Export promoting or import substituting strategy
Basu et al. (2003)	Positive	Bidirectional/unidirectional causality from growth to FDI
Borensztein et al. (1998)	Positive	Conditional on the level of human capital
Carkovic & Levine (2002)	Ambiguous	No evidence
Choe (2003)	Positive	Bidirectional causality but more apparent from growth to FDI
Chowdhury & Mavrotas (2006)	Positive	Bidirectional/unidirectional causality from growth to FDI
De Mello (1999)	Positive/negative	Conditional on the observable and unobservable country-specific factors
Dees (1998)	Positive	Conditional on the transmission of ideas
Durham (2004)	Ambiguous	Conditional on the financial or instructional development
Haddad & Harrison (1993)	Positive	Limited evidence
Hermes & Lensink (2003)	Positive	Conditional on the development of financial market
Herzer et al. (2008)	Ambiguous	No short-term or long-term evidence
Keshava (2008)	Positive	Limited evidence
Li & Liu (2005)	Positive	Conditional on the level of human capital and technological gap
Liu (2008)	Positive/negative	Conditional on the short-term productivity level and long-term rate of productivity growth
Nair-Reichert & Weinhold (2001)	Positive	Unidirectional causality from FDI to growth
Noorbakhsh et al. (2001)	Positive	Conditional on the level of human capital
Tsai (1994)	Positive	Limited evidence but conditional on the geographical differences
Tseng & Zebregs (2002)	Positive	Conditional on openness

Table A2: List of 54 developing countries

BRIC countries	Non-BRIC countries		
	Asia & Middle East	**North & Sub-Saharan Africa**	**Central & Latin America**
Brazil	Bangladesh	Algeria	Argentina
Russia	Cambodia	Botswana	Belize
India	Indonesia	Burundi	Bolivia
China	Iran	Cameroon	Colombia
	Jordan	Cote d'Ivoire	Costa Rica
	Malaysia	Egypt	Dominican Republic
	Mongolia	Ghana	Ecuador
	Nepal	Gabon	El Salvador
	Pakistan	Kenya	Guatemala
	Papua New Guinea	Morocco	Guyana
	Philippines	Niger	Honduras
	Sri Lanka	Rwanda	Mexico
	Tajikistan	Senegal	Nicaragua
	Thailand	South Africa	Paraguay
	Vietnam	Swaziland	Peru
		Togo	Venezuela
		Tunisia	
		Zambia	
		Zimbabwe	

Table A3: Definition of variables and data sources

Symbol	Variable	Source of data
y_{it}	GDP per capita (constant 2005 US$)	World Bank & OECD National Accounts database
k_{it}	Gross domestic investment (% of GDP)	World Bank & OECD National Accounts database
f_{it}	Foreign direct investment, net inflows (% of GDP)	International Financial Statistics & World Bank estimate
h_{it}	Education index (1 = perfect education attainment) = (expected years of school + mean years of school)/2	UNDP Human Development reports/UNESCO Institute for Statistics & Barro-Lee dataset (2013)
T_{it}	Openness index (% of GDP) = total exports + total imports	World Bank & OECD National Accounts database
I_{it}	Infrastructure (telephones lines per 100 people)	World Telecommunication/ICT Development reports & World Bank estimate
C_{it}	Freedom rating (1 = most politically stable economy) = (political rating + civil rating)/2	Freedom House reports & dataset

Table A4: Summary statistics for all countries

Variable	Obs	Mean	Std. Dev.	Min	Max
lny_{it}	370	7.1431	0.9692	4.9948	9.0047
lnf_{it}	349	0.0247	1.4660	-5.5699	2.9003
h_{it}	376	0.4434	0.1429	0.0598	0.7730
lnk_{it}	370	2.9710	0.3647	1.6626	4.1551
lnT_{it}	365	4.0824	0.5588	2.4463	5.4849
I_{it}	370	4.9734	5.9845	0.0323	33.9819
C_{it}	371	4.1612	1.5578	1	7

Table A5: Summary statistics for BRIC countries

Variable	Obs	Mean	Std. Dev.	Min	Max
lny_{it}	26	7.2880	1.1785	5.3956	8.7412
lnf_{it}	24	-0.1867	1.4710	-3.5880	1.4352
h_{it}	28	0.4967	0.1493	0.2401	0.7730
lnk_{it}	26	3.1976	0.3254	2.6217	3.7167
lnT_{it}	26	3.3529	0.5113	2.6068	4.1325
I_{it}	28	9.4757	9..4021	0.2177	31.4189
C_{it}	25	4.0720	1.7286	2	7

Table A6: Summary statistics for non-BRIC countries

Variable	Obs	Mean	Std. Dev.	Min	Max
lny_{it}	344	7.1322	0.9527	4.9948	9.0047
lnf_{it}	325	0.0403	1.4667	-5.5699	2.9003
h_{it}	348	0.4391	0.1418	0.0598	0.7460
lnk_{it}	344	2.9539	0.3622	1.6626	4.1551
lnT_{it}	339	4.1383	0.5223	2.4463	5.4849
I_{it}	342	4.6048	5.4731	0.0323	33.9819
C_{it}	346	4.1676	1.5472	1	7

Table A7: Correlation matrix

	Δlny_{it}	Δlnf_{it}	Δh_{it}	Δlnk_{it}	ΔlnT_{it}	ΔI_{it}	ΔC_{it}
Δlny_{it}	1.0000						
Δlnf_{it}	0.1117*	1.0000					
Δh_{it}	0.1601***	-0.1775***	1.0000				
Δlnk_{it}	0.2799***	-0.0618	0.1561***	1.0000			
ΔlnT_{it}	0.1230**	0.1642***	0.0914	0.3265***	1.0000		
ΔI_{it}	0.3032***	0.0379	0.1084*	0.0615	0.1247**	1.0000	
ΔC_{it}	0.0978*	-0.0048	-0.0067	0.0405	-0.0628	0.0383	1.0000

Note: Each row shows the correlation coefficient for the macroeconomic variables of all countries in study. ***, ** and * indicates the significance of each at 1%, 5% and 10% respectively.

Table A8: CRE model results

Depending variable: Δlny_{it}							
	CRE						
	[M1]	**[M2]**	**[M3]**	**[M4]**	**[M5]**	**[M6]**	**[M7]**
Intercept	-0.1085***	-0.1114***	-0.1035***	-0.1177***	-0.1052***	-0.1055***	-0.1056***
	(0.0359)	(0.0358)	(0.0355)	(0.0361)	(0.0358)	(0.0359)	(0.0252)
Δlnf_{it}	0.0057	0.0088	0.0103*	0.0122*	0.0136**	0.0135**	0.0136**
	(0.0052)	(0.0054)	(0.0058)	(0.0063)	(0.0065)	(0.0066)	(0.0066)
Δh_{it}	-	0.7627*	0.5657	0.6204	0.6106	0.6083	0.6001
		(0.4058)	(0.3928)	(0.3961)	(0.3936)	(0.3897)	(0.3891)
Δlnk_{it}	-	-	0.1034***	0.1207***	0.1193***	0.1187***	0.1190***
			(0.0291)	(0.0318)	(0.0304)	(0.0307)	(0.0307)
ΔlnT_{it}	-	-	-	-0.0877	-0.0958	-0.0938	-0.0949
				(0.0707)	(0.0698)	(0.0712)	(0.0712)
ΔI_{it}	-	-	-	-	0.0067*	0.0066*	0.0065*
					(0.0035)	(0.0035)	(0.0035)
ΔC_{it}	-	-	-	-	-	0.0041	0.0039
						(0.0114)	(0.0114)
BRIC	-	-	-	-	-	-	3.2831***
							(0.3275)
Observations	288	288	288	285	282	282	282
R-squared							
Within	0.1996	0.2238	0.2714	0.2983	0.3101	0.3108	0.3108
Between	0.4326	0.4388	0.4410	0.4279	0.4204	0.4207	0.4892
Overall	0.3063	0.3220	0.3498	0.3572	0.3670	0.3675	0.4013

Note: M denotes model, for instance, M1 is Model 1 and so on. Each row shows the average coefficient along with the robust standard error in parenthesis for the macroeconomic variables of all countries in study. ***, ** and * indicates the significance of each at 1%, 5% and 10% respectively.

Table A9: CRE/FGLS model results (continuation)

Depending variable: Δlny_{it}							
	CRE						**FGLS**
	[M8]	**[M9]**	**[M10]**	**[M11]**	**[M12]**	**[M13]**	**[M14]**
Intercept	-0.1058***	-0.1045***	-0.1019***	-0.0102***	-0.1016***	-0.1016***	-0.1220***
	(0.0356)	(0.0358)	(0.0360)	(0.0361)	(0.0361)	(0.0361)	(0.0175)
Δlnf_{it}	0.0137**	0.0142**	0.0140**	0.0140**	0.0140**	0.0140**	0.0091*
	(0.0066)	(0.0066)	(0.0065)	(0.0065)	(0.0065)	(0.0065)	(0.0047)
Δh_{it}	0.6018	0.6872*	0.6828*	0.6795*	0.6797*	0.6800*	0.3889
	(0.3881)	(0.3885)	(0.3899)	(0.3930)	(0.3935)	(0.3946)	(0.2430)
Δlnk_{it}	0.1184***	0.1132***	0.1085***	0.1078***	0.1079***	0.1078***	0.0900***
	(0.0309)	(0.0305)	(0.0307)	(0.0312)	(0.0312)	(0.0313)	(0.0227)
ΔlnT_{it}	-0.0946	-0.0940	-0.0943	-0.0919	-0.0919	-0.0919	-0.0261
	(0.0720)	(0.0731)	(0.0740)	(0.0769)	(0.0770)	(0.0771)	(0.0276)
ΔI_{it}	0.0065*	0.0067**	0.0073**	0.0075**	0.0075*	0.0075*	0.0035
	(0.0036)	(0.0034)	(0.0034)	(0.0034)	(0.0039)	(0.0039)	(0.0030)
ΔC_{it}	0.0041	0.0057	0.0048	0.0049	0.0049	0.0050	0.0129**
	(0.0116)	(0.0120)	(0.0119)	(0.0120)	(0.0120)	(0.0123)	(0.0058)
BRIC	3.2827***	3.5935***	3.3643***	3.4215***	3.4136***	3.4178***	3.6632***
	(0.3281)	(0.3442)	(0.3422)	(0.3505)	(0.4519)	(0.4579)	(0.4674)
Δlnf_{it}***BRIC**	-0.0061	-0.0117	0.0574*	0.0621**	0.0625*	0.0638*	0.0665***
	(0.0280)	(0.0265)	(0.0319)	(0.0291)	(0.0334)	(0.0332)	(0.0246)
Δh_{it}***BRIC**	-	-4.1680***	-1.8966*	-1.8577**	-1.8550**	-1.8057*	-0.7897
		(1.4709)	(0.9834)	(0.8978)	(0.9371)	(1.0097)	(0.8943)
Δlnk_{it}***BRIC**	-	-	0.4565**	0.4687**	0.4698**	0.4724**	0.3911***
			(0.2059)	(0.2039)	(0.2187)	(0.2104)	(0.1102)
ΔlnT_{it}***BRIC**	-	-	-	-0.0429	-0.0444	-0.0430	-0.0364
				(0.0750)	(0.0755)	(0.0871)	(0.0659)
ΔI_{it}***BRIC**	-	-	-	-	0.0002	0.0001	0.0008
					(0.0052)	(0.0056)	(0.0053)
ΔC_{it}***BRIC**	-	-	-	-	-	-0.0026	-0.0287
						(0.0326)	(0.0184)
Observations	282	282	282	282	282	282	282
R-squared							
Within	0.3108	0.3286	0.3419	0.3422	0.3421	0.3421	-
Between	0.4893	0.4895	0.4878	0.4877	0.4878	0.4878	-
Overall	0.4014	0.4111	0.4178	0.4179	0.4180	0.4180	-

Note: M denotes model, for instance, M8 is Model 8 and so on. Each row shows the average coefficient along with the robust standard error in parenthesis for the macroeconomic variables of all countries in study. ***, ** and * indicates the significance of each at 1%, 5% and 10% respectively.

Table A10: Robust Hausman test result

Statistic	559.28
Prob>chi2	0.0000

Note: Test statistic and p-value are from a fully robust Wald test applied to the vector of time averages in Model 13.

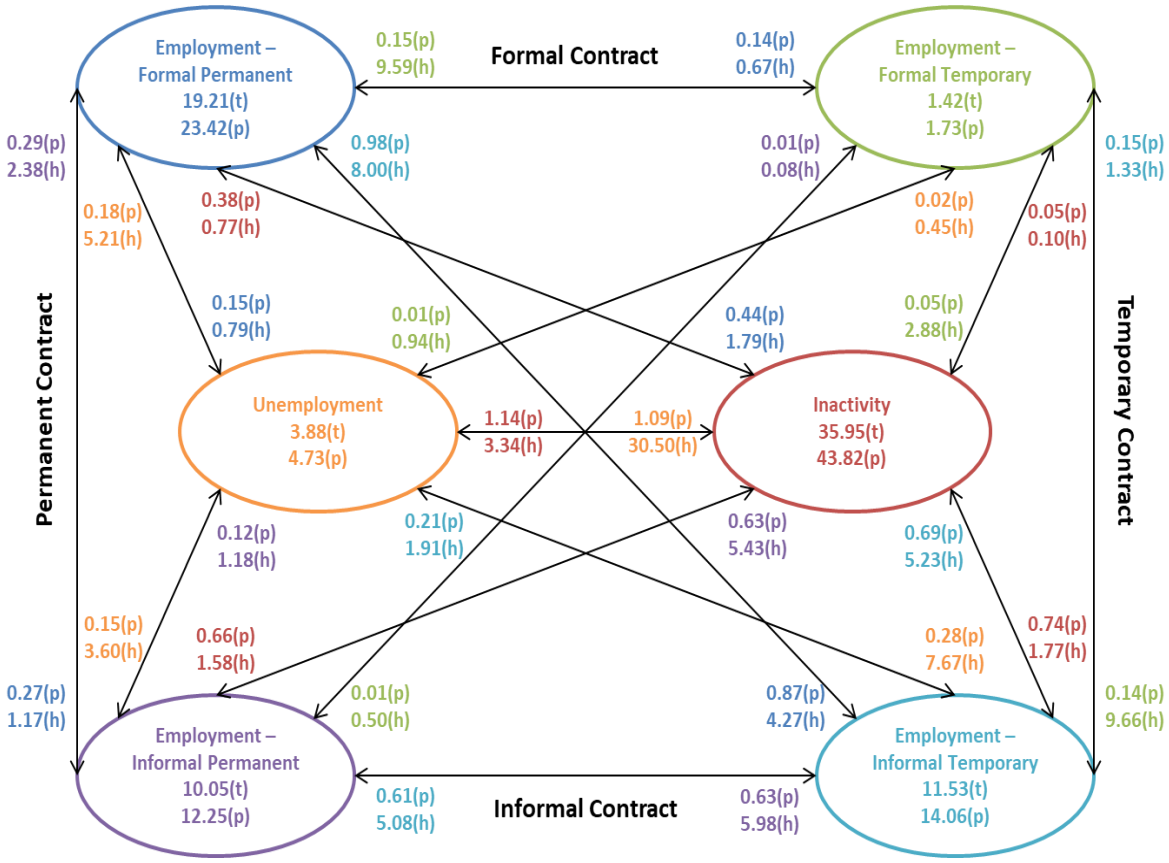
Appendix B

Table B1: Size of the informal sector by sub-group: Gender, age and education.

Informal sector			
		In thousands	% of working-age population
Gender			
	Male	11.52	14.04
	Female	10.06	12.27
Age			
	Young workers (under 24yrs)	3.33	4.06
	Prime-age workers (25-49yrs)	12.63	15.39
	Older workers (over 50ys)	5.62	6.86
Education			
	Primary	8.50	10.35
	Secondary	6.38	7.77
	Tertiary	3.95	4.81

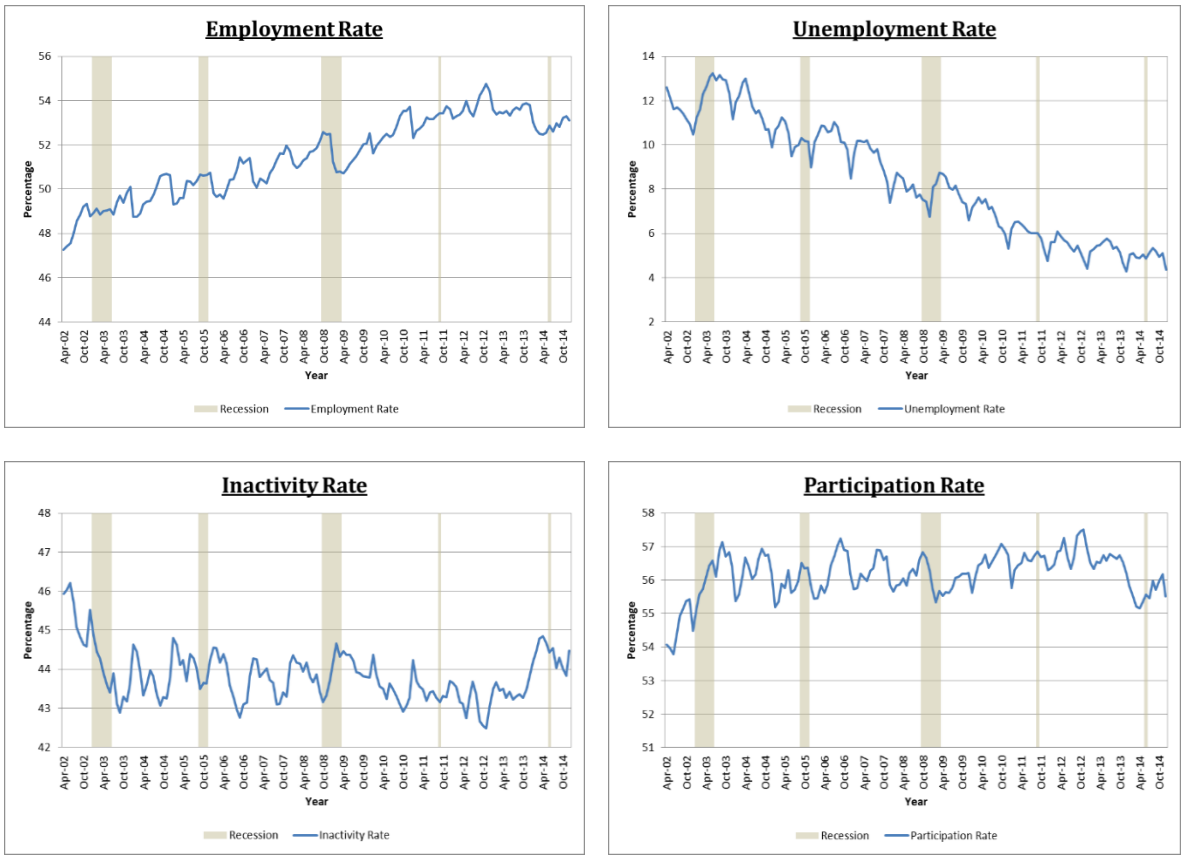
Note: Average size of different sub-groups of informal sector workers in Brazil based on own elaboration using new Monthly Employment Survey (PME-Nova).

Figure B1: Monthly average gross flows: 2002:04 – 2014:12.



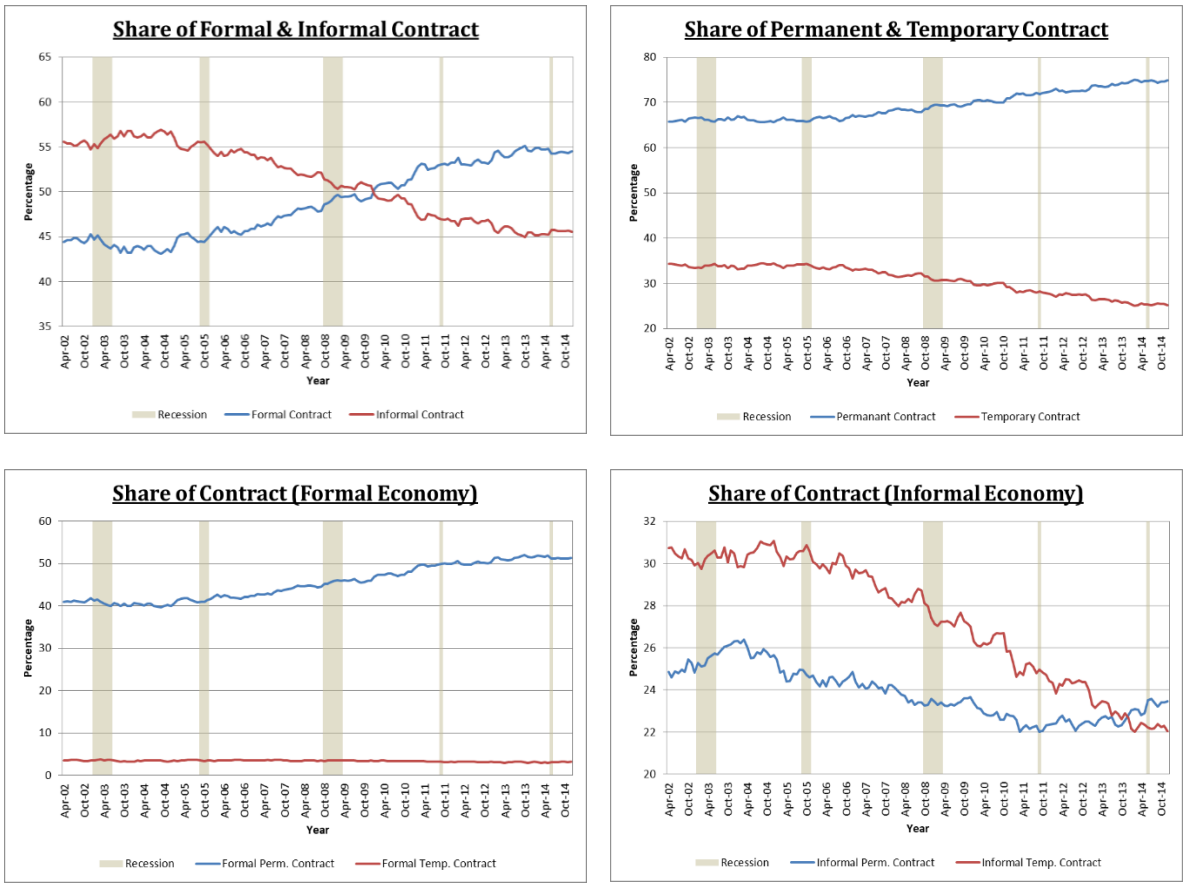
Note: Worker stocks and flows are expressed as total number of individuals in thousands (t), as a percentage of the working-age population (p) or as a hazard rate (h) based on own elaboration using new Brazilian Monthly Employment Survey (PME-Nova).

Figure B2: Evolution of the key labour market indicators: 2002:04 – 2014:12.



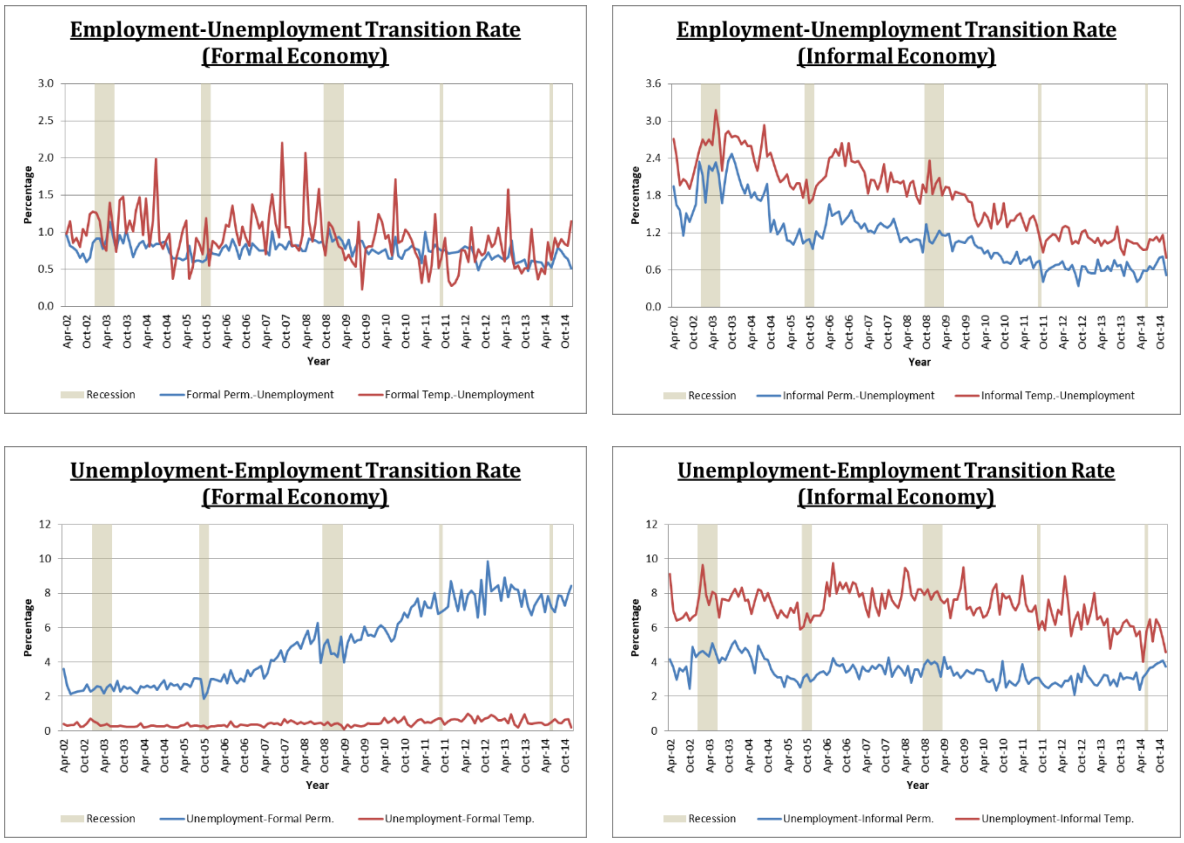
Note: Own elaboration based on new Brazilian Monthly Employment Survey (PME-Nova).

Figure B3: Evolution of the share of contracts: 2002:04 – 2014:12.



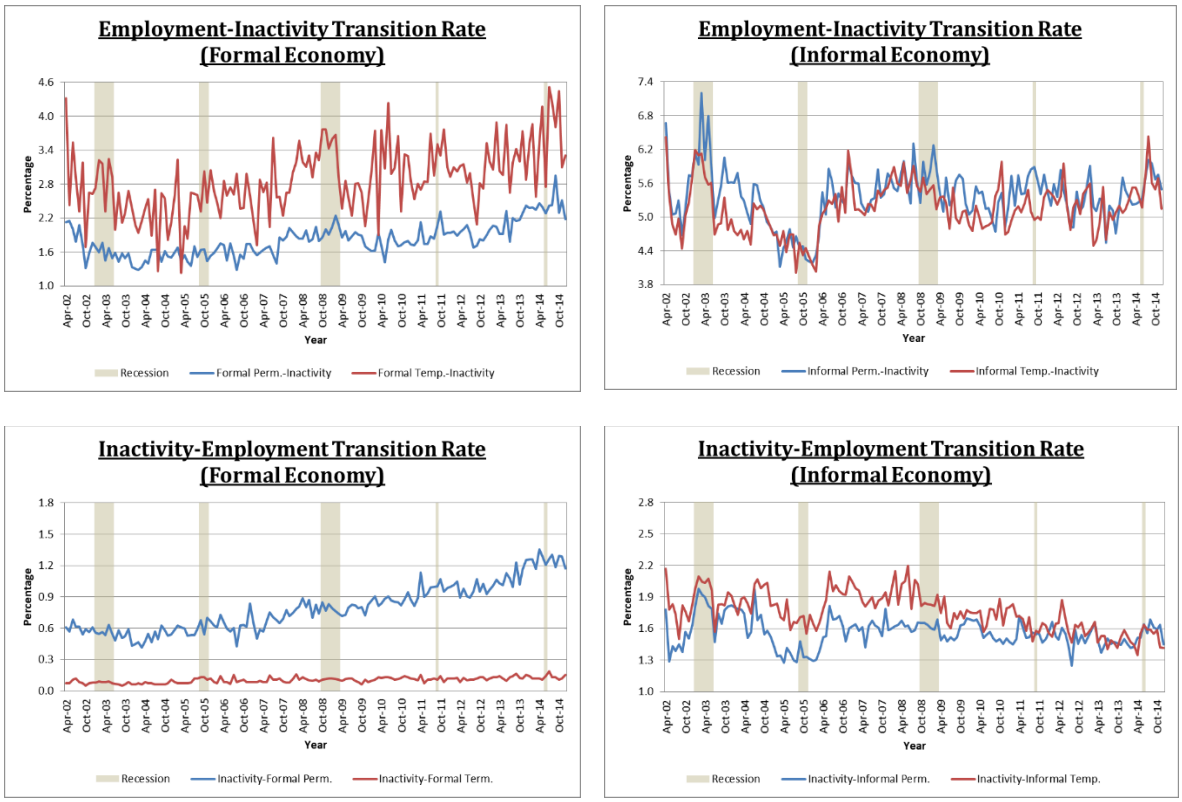
Note: Own elaboration based on new Brazilian Monthly Employment Survey (PME-Nova).

Figure B4: Dynamics of transition rates to and from unemployment and employment: 2002:04 – 2014:12.



Note: Own elaboration based on new Brazilian Monthly Employment Survey (PME-Nova).

Figure B5: Dynamics of transition rates to and from inactivity and employment: 2002:04 – 2014:12.



Note: Own elaboration based on new Brazilian Monthly Employment Survey (PME-Nova).

Table B2: Transition rates: Brazil, Spain, UK and US.

Monthly average (in %)								
		Brazil		**Spain**		**UK**	**US**	
E-U		1.14		0.73		0.63	3.16	
	FP-U		0.76		0.15			
	FT-U		0.91		2.66			
	IP-U		1.14					
	IT-U		1.81					
U-E		5.09		4.83		9.98	49.83	
	U-FP		5.00		0.41			
	U-FT		0.43		4.91			
	U-IP		3.46					
	U-IT		7.22					
E-I		3.61		0.67		0.61	3.31	
	FP-I		1.81		0.37			
	FT-I		2.88		0.69			
	IP-I		5.37					
	IT-I		5.17					
I-E		1.22		0.70		1.73	4.96	
	I-FP		0.79		0.20			
	I-FT		0.10		0.24			
	I-IP		1.56					
	I-IT		1.76					
U-I		28.80		3.01		6.92	46.38	
I-U		3.16		0.58		1.95	6.29	
	FP-FT		0.65		0.49			
	FT-FP		9.35		2.16			
	IP-IT		5.78					
	IT-IP		4.91					
	FP-IP		1.17					
	IP-FP		2.38					
	FT-IT		9.26					
	IT-FT		1.27					
	FP-IT		4.15					
	IT-FP		7.78					
	FT-IP		0.55					
	IP-FT		0.08					

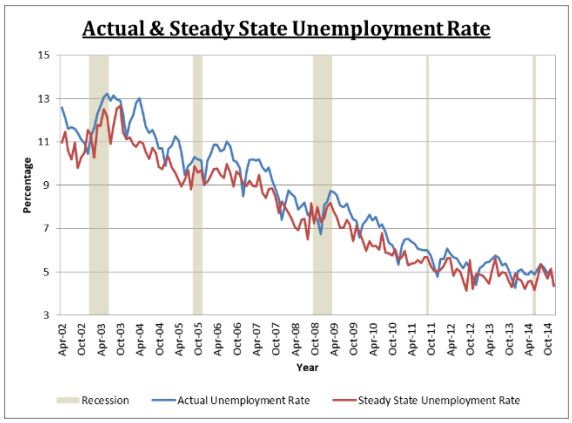
Note: The transition rates for Brazil are based on own elaboration using new Monthly Employment Survey (PME-Nova). While those for Spain, UK and US are taken from Silva & Vazquez-Grenno (2013) for the purpose of comparison. All series have been seasonally adjusted and corrected for multiple transition bias.

Table B3: Unconditional cross-correlation between logged GDP and transition rates: 2002:04 – 2014:12.

Quarterly average: GDP (t ± i)									
	t - 4	**t - 3**	**t - 2**	**t - 1**	**t**	**t + 1**	**t + 2**	**t + 3**	**t + 4**
FP-FT	0.087	-0.002	-0.099	-0.019	0.124	0.276	0.221	-0.008	-0.092
FP-U	0.092	0.050	-0.026	-0.169	-0.149	-0.034	0.160	0.192	0.268
FP-I	**-0.344***	**-0.326***	-0.246	-0.207	-0.163	0.029	0.251	**0.296***	0.269
FP-IP	-0.238	-0.241	-0.078	-0.001	0.050	0.234	0.258	0.181	0.033
FP-IT	-0.104	-0.054	-0.106	-0.174	-0.058	0.111	0.174	0.118	-0.032
FT-FP	-0.094	-0.051	-0.059	-0.030	0.197	**0.396***	**0.433***	0.218	0.075
FT-U	0.166	0.139	0.061	0.205	0.167	0.127	-0.041	-0.252	**-0.328***
FT-I	-0.155	-0.277	-0.178	-0.189	-0.071	**0.280***	**0.407***	0.223	0.026
FT-IP	-0.023	-0.098	-0.050	-0.068	-0.009	0.205	**0.331***	**0.363***	**0.353***
FT-IT	-0.160	-0.077	-0.136	-0.035	0.001	0.003	-0.108	-0.079	0.056
U-FP	**-0.290***	-0.114	0.241	**0.496***	**0.601***	**0.512***	**0.334***	0.208	0.134
U-FT	-0.118	0.093	0.199	**0.371***	**0.440***	**0.466***	**0.349***	0.089	-0.072
U-I	**-0.317***	**-0.367***	-0.249	-0.077	0.095	0.199	0.258	0.196	0.216
U-IP	0.154	0.154	0.015	-0.244	**-0.325***	-0.276	-0.169	-0.070	-0.008
U-IT	0.061	-0.006	0.003	0.069	0.029	0.031	0.033	-0.083	0.064
I-FP	**-0.358***	**-0.425***	-0.238	-0.025	0.161	**0.334***	**0.290***	0.212	0.053
I-FT	-0.206	-0.267	0.047	0.000	0.002	0.152	0.225	0.185	-0.019
I-U	0.271	0.224	0.060	-0.228	**-0.441***	**-0.343***	-0.193	-0.139	0.005
I-IP	0.152	0.158	0.053	-0.062	-0.097	0.011	0.005	-0.150	-0.117
I-IT	-0.116	-0.100	0.024	0.148	0.137	0.185	0.218	0.013	-0.077
IP-FP	-0.237	-0.165	-0.059	0.059	0.197	**0.308***	0.273	0.160	-0.018
IP-FT	0.001	-0.131	-0.190	-0.037	0.104	0.231	0.186	-0.020	0.042
IP-U	0.255	0.267	0.082	-0.149	**-0.322***	-0.279	-0.201	-0.126	0.025
IP-I	0.083	-0.001	-0.052	-0.103	-0.110	0.038	0.177	0.092	0.136
IP-IT	0.106	0.108	0.093	-0.053	0.013	0.108	0.132	0.041	0.000
IT-FP	-0.240	-0.202	-0.180	-0.098	0.120	**0.360***	**0.405***	0.249	0.121
IT-FT	-0.134	-0.228	**-0.309***	**-0.364***	**-0.323***	-0.012	0.199	**0.290***	0.249
IT-U	0.183	0.134	0.025	-0.224	**-0.356***	-0.248	-0.144	-0.029	0.125
IT-I	-0.108	-0.122	-0.064	-0.099	0.030	0.186	**0.288***	0.217	0.130
IT-IP	0.164	0.117	0.018	-0.107	-0.134	-0.068	0.043	-0.022	0.055

Note: FP represents formal permanent employment; FT formal temporary employment; IP informal permanent employment; IT informal temporary employment; U unemployment and I Inactivity. X-Y refers to the transition rate from state X to state Y. * indicates statistical significance at 5%. Based on own elaboration using new Brazilian Monthly Employment Survey (PME-Nova).

Figure B6: Actual and steady state unemployment rates: 2002:04 – 2014:12.



Note: Own elaboration based on new Brazilian Monthly Employment Survey (PME-Nova). The steady state unemployment rate is computed from the steady state of unemployment, formal permanent, formal temporary, informal permanent and informal temporary employment $\left(\frac{U_t^{SS}}{U_t^{SS}+FP_t^{SS}+FT_t^{SS}+IP_t^{SS}+IT_t^{SS}}\right)$.

Table B4: Unemployment decomposition: 2002:04 – 2014:12.

6-state model: Contribution (in %)		
	Shimer Methodology	**Fujita & Ramey Methodology**
Job finding rates		
U-FP	6.0805	7.2483
U-FT	0.2024	0.1387
U-IP	-5.5305	-5.0629
U-IT	-1.8946	-1.0984
I-FP	3.1826	3.0731
I-FT	0.3127	0.3249
I-IP	-5.5868	-4.2079
I-IT	-1.3648	-0.6751
Job separation rates		
FP-U	11.3435	12.6637
FT-U	0.4672	0.5130
IP-U	15.5954	13.0843
IT-U	16.8721	14.5738
FP-I	1.5540	3.4310
FT-I	-0.0253	0.1178
IP-I	8.0281	7.5703
IT-I	5.1639	5.1749
Job reallocation rates		
FP-FT	0.1230	0.0154
FT-FP	-0.1533	-0.0880
IP-IT	-0.2122	-0.3223
IT-IP	0.2455	0.3803
FP-IP	0.5523	0.6494
IP-FP	-0.0640	-0.0890
FT-IT	0.0546	0.0094
IT-FT	-0.1041	-0.1074
FP-IT	1.7022	1.4141
IT-FP	-0.0404	0.0375
FT-IP	0.0546	0.0589
IP-FT	-0.0345	-0.0360
U-I	15.5758	16.6408
I-U	24.1737	24.2348

Note: Contributions are obtained by dividing each covariance between the steady state unemployment rate, u_t^{ss} and the counterfactual unemployment rate (assuming that all transition rates expect one are at their sample average or HP trend values) by the variance of u_t^{ss}. All series are de-trended using a HP filter with the standard smoothing parameter of 1600. Based on own elaboration using new Brazilian Monthly Employment Survey (PME-Nova).

Additional notes: Brazilian Monthly Employment Survey (PME)

The PME is an in-depth household monthly interview on 6 of the county's major metropolitan regions, covering about 25% of the national labour market. It is conducted by IBGE to account for the labour market activities and demographic changes for members of the household over the age of 10. Despite it being only representative of the urban labour market, the PME is structured as a rotating panel which makes it ideal to study on worker flows when compared to other surveys like the National Household Survey (PNAD).

- **Tracking worker transitions**

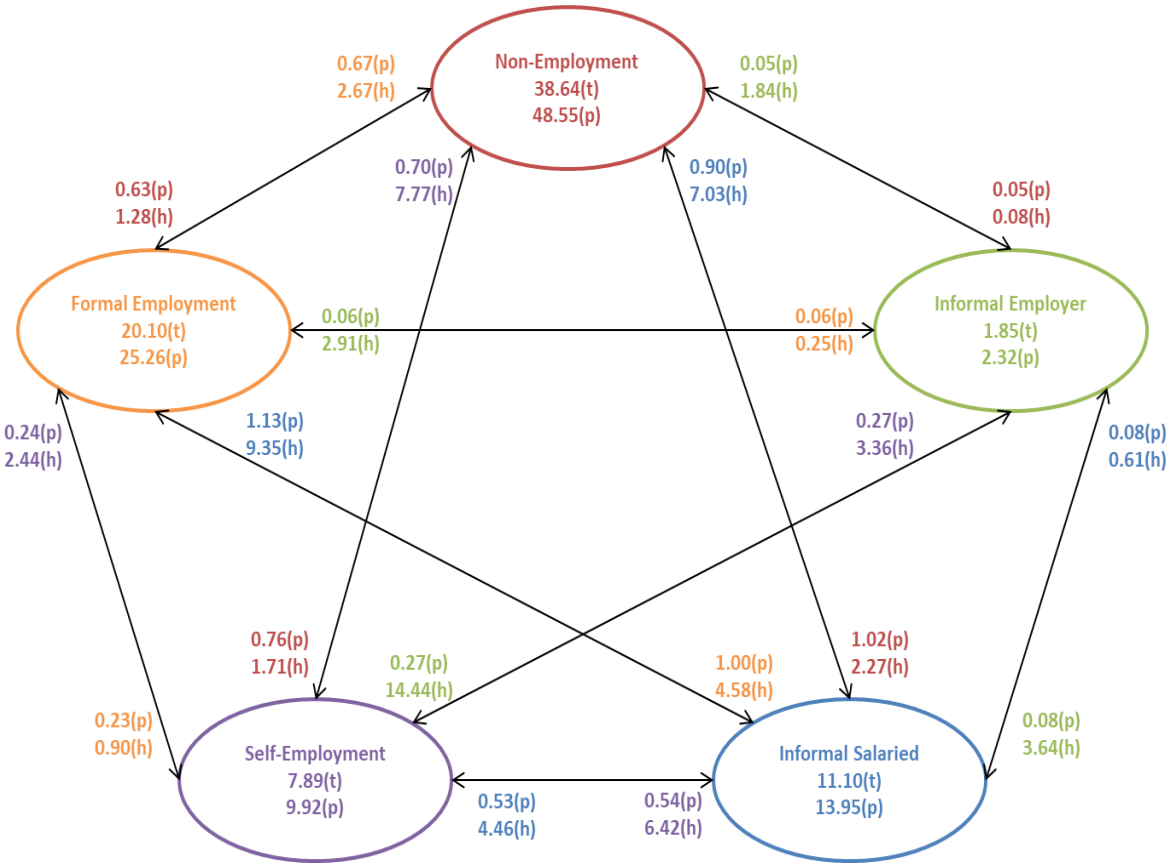
With the PME, one has to be very careful on how the worker transitions are tracked and in turn flows are computed. Although the PME correctly identifies household throughout all 8 interviews, it does not assign the same identification number to each individual in the household, making it impossible to track them correctly across the interviews. This is a major issue particularly because it implies that each row of data in the monthly survey do not necessarily represent the same worker and as such recording the month-to-month status changes will lead to spurious flows. A way to overcome this problem is to establish some form of ID which in our case are obtained from the Data Zoom package developed by the Department of Economics at PUC-Rio. It offers identification algorithms based on Ribas & Soares (2008) where these algorithms differ according to the number of characteristics assessed in order to identify and correctly track the same individual across the interviews.

- **Assigning missing contracts**

Just like any other survey, there are missing information in the PME with regards to the overall market status, sector of operation, contract type etc. as individuals may not have responded or data may not have been correctly recorded in the follow-up interviews. The unconditional non-responses vary between 11 to 17% of the sample which is resolved by implementing the missing-at-random technique which drops the missing observations and re-weights the measured transitions. To be specific, we apply the technique to the variable vD1 which represents a worker's overall market status i.e. whether he/she is employed, unemployed or inactive and effectively remove approximately 18% of the survey observations. Unfortunately, despite the significant reduction in sample attrition, missing information is still observed with regards to the individual's sector of operation (represented by the variable v415) and as such makes it impossible to establish their respective contract type (represented by the variables vD15 & vD18) i.e. formal temporary, formal permanent, informal temporary or informal permanent. We fix this by assigning these workers in accordance to the degree of informality in Brazil which based on IPEA estimate lies between 38 to 49% since 2002 onwards within the metropolitan regions.

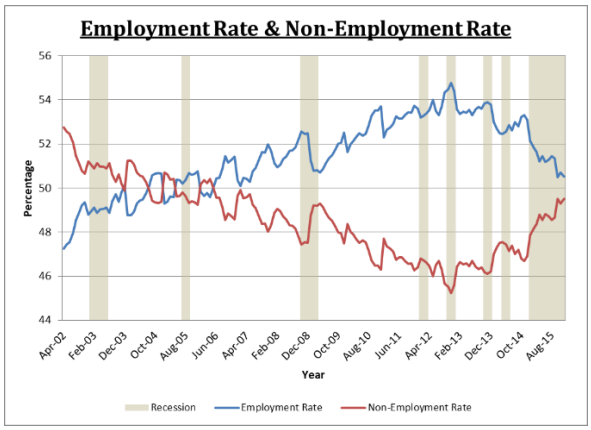
Appendix C

Figure C1: Monthly average gross flows: 2002:04 – 2015:12.



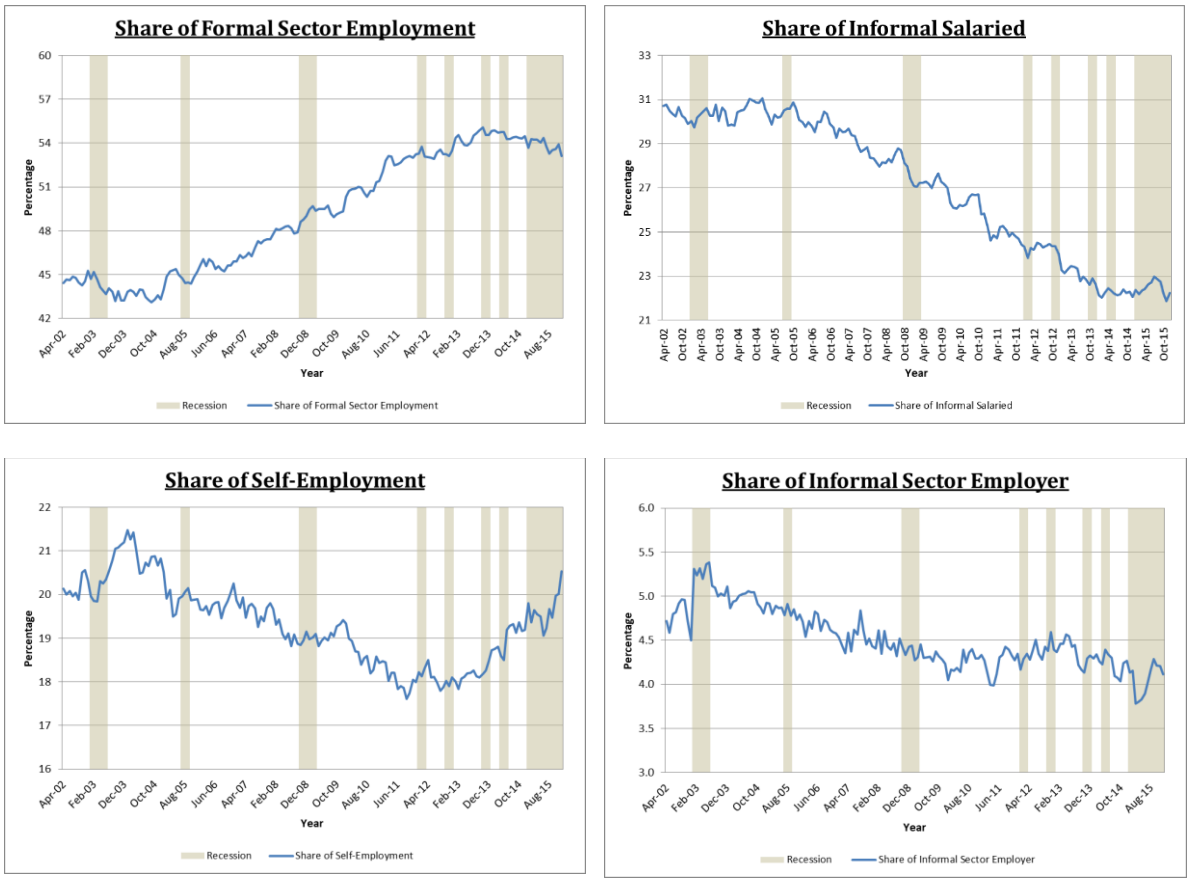
Note: Worker stocks and flows are expressed as total number of individuals in thousands (t), as a percentage of the working-age population (p) or as a hazard rate (h) based on own elaboration using new Brazilian Monthly Employment Survey (PME-Nova).

Figure C2: Evolution of the key labour market indicators: 2002:04 – 2015:12.



Note: Own elaboration based on new Brazilian Monthly Employment Survey (PME-Nova).

Figure C3: Evolution of the share of different types of employment: 2002:04 – 2015:12.



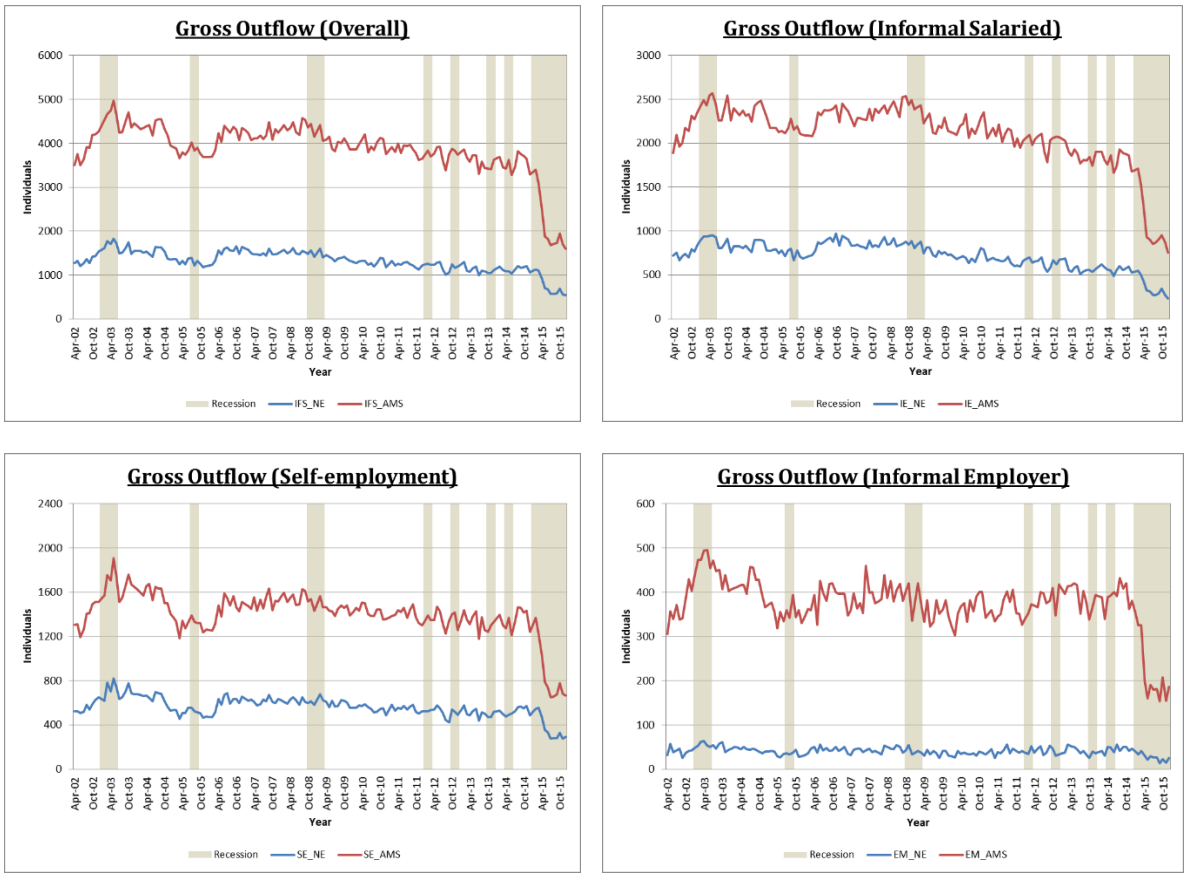
Note: Own elaboration based on new Brazilian Monthly Employment Survey (PME-Nova).

Table C1: Transition rates: Brazil.

Monthly averages (in %)		
		Brazil
FE-NF		8.27
	FE-NE	2.67
	FE-SE	0.91
	FE-EM	0.25
	FE-IE	4.45
NF-FE		3.76
	NE-FE	1.29
	SE-FE	2.45
	EM-FE	2.89
	IE-FE	9.07
	NE-SE	1.67
	NE-EM	0.09
	NE-IE	2.23
	SE-NE	7.62
	SE-EM	3.21
	SE-IE	6.18
	EM-NE	1.94
	EM-SE	13.80
	EM-IE	3.59
	IE-NE	6.89
	IE-SE	4.30
	IE-EM	0.60

Note: FE represents formal sector employment; NF non-formal sector; NE non-employment; SE self-employment; EM informal employer and IE informal salaried. All the transition rates are based on own elaboration using new Brazilian Monthly Employment Survey (PME-Nova).

Figure C4: Evolution of the gross outflow from informality: 2002:04 – 2015:12.



Note: Own elaboration based on new Brazilian Monthly Employment Survey (PME-Nova).

Table C4: Model parameters.

Parameter	Value	Source
r	0.0880	World Bank
η	0.5000	Estimate
c	-0.0507	Calibration
p_F	1.0000	Estimate
m	0.0884	Calibration
δ	0.2481	PME
λ_a	0.5764	PME
λ_b	0.3202	PME
ζ	0.7755	PME
p_I	0.4204	PME
$\overline{b}$	0.2214	PME
$\overline{\overline{a}}$		
Ω	0.0750	Secretariat of the Federal Revenue Brazil

Table C5: Simulation results.

Parameter	Ω = 7.5%*	Ω = 15%	Ω = 22.5%	Ω = 27.5%
$\overline{f}$	0.2841	0.2841	0.2841	0.2841
w_I	0.2239	0.2239	0.2239	0.2239
$\overline{N}$	3.7633	3.7283	3.6977	3.6792
$\overline{W}$	4.8296	4.8655	4.9004	4.9231
$\overline{V}$	0.0000	0.0000	0.0000	0.0000
$\overline{J}$	1.1463	1.3078	1.4734	1.5859
w_F	0.6897	0.7104	0.7298	0.7419
θ	1.0004	0.8769	0.7784	0.7232
$\dot{\gamma_N}$	0.8487	0.8649	0.8782	0.8859
m	0.0884	0.0828	0.0780	0.0752
du	11.3097	12.0799	12.8219	13.3025
G	0.0517	0.1066	0.1642	0.2040
κ	1.8991	1.8991	1.8991	1.8991
ζ	0.7755	0.7755	0.7755	0.7755

* indicates that the column of values underneath is for the baseline economy.

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