THREE ESSAYS ON DISTRIBUTION AND ECONOMIC EXPANSION OF A DUAL ECONOMY

by

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ABSTRACT

This dissertation aims to investigate the evolutionary process of a dual economy, using the Structuralist approach. In this sense, the work is divided in three parts. Firstly, we make a brief introduction of the literature on the dynamic between distribution and economic expansion. Specifically, it discusses the Structuralist approach to a dual, open-economy. The review of this model suggests that further research that incorporates distributive issues might be a fertile avenue (area) to accomplish a better understanding of a developing economy.

The second part presents a methodology to estimate a Social Accounting Matrix for Brazil in 2006 that separates between formal and informal sectors. The goal of this study is to estimate and to analyze the Social Accounting Matrix for Brazil in 2006. The shares of output by informal and formal sectors are applied as weights to estimate the size of the two sectors. The results reveal important structural linkages between the two sectors and may serve as data input for future Structuralist Calibrated models.

Thirdly, the last part presents a dual, open-economy model that describes the schematic behavior of the Brazilian economy. We compare the short-run effects of two major experiments: an income transfer toward workers in the modern sector and an income transfer to workers from the subsistence sector, and discuss them in the context of Brazil. The results suggest that redistribution under certain conditions may lead to economic expansion.

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CHAPTER 1

THE DUAL ECONOMY AND THE STRUCTURALIST MODEL

1.1 Introduction

Weak economic performance is a problem that affects many countries. Low economic activity can induce the economy into a vicious-cycle characterized by high unemployment and low productivity. Lack of effective demand is one of the factors that may explain the poor economic performance for a group of countries. However, a strong rise in demand can stimulate production in the dynamic sectors resulting in economies of scale, an increase in labor productivity, and economic expansion.

In the same vein, a redistribution of income toward labor may be capable of boosting demand and economic activity. Redistribution can increase the size of the domestic market, generating substantial economies of scale. Furthermore, if income redistribution toward labor leads to improvement in education and health, it will also generate more productive labor and therefore economic growth in the long run. In some countries where it matters, the resulting reduction of political instability can benefit institutional reforms and the provision of public goods in a way that makes political agreements easier to achieve.

The purpose of this chapter is to present a brief introduction of the literature on the

distribution, economic expansion, and background for the Brazilian economy. Moreover, a structuralist dual model that attempts to describe the Brazilian economy after 1994 is presented.

This chapter is organized as follows. Following this introduction, we briefly introduce some of the discussion on the relationship between the distribution of income and development. Subsection 3 gives a brief background on the Brazilian economy: the profound problem of inequality is presented in this section. Subsection 4 presents the one sector structuralist model. Subsection 5 presents the dual model for the Brazilian economy. Finally, Subsection 6 is reserved for conclusions.

1.2 Income Inequality and Economic Development

Economic development is the result of profound structural transformation toward dynamic activities characterized by dynamic economies of scale.[1] In this dissertation we adopt the view that the complex interaction between supply and demand factors plays an important role in generating economic success. This is underpinned by the bi-directional causality between economic growth and labor productivity.

A strong rise in demand can stimulate production in the dynamic sectors, resulting in economies of scale and an increase in labor productivity. Known as the Kaldor-Verdoorn Law, hereafter KV, it implies that technical progress is endogenous. (Kaldor 1978, McCombie 1983).[2] In the Keynesian and Kaleckian approaches, economic growth is demand driven and investment is treated as an independent function. In fact,

[1]Dynamic economies of scale are generated by technological progress, learning by doing, external economies and division of labor. The learning by doing process can improve the ability to implement innovations.

[2]KV law defines a positive relationship between the growth rate of labor productivity and production in the industrial sector.

research on Brazil has demonstrated the validity of the accelerator theory and the KV Law.[3]

Conversely, neoclassical models suggest that the supply side determines economic growth and labor productivity works as the main source of economic growth. In the neoclassical approach, growth is supply driven; in other words, economic growth is driven by savings. According to Ocampo (2005), in the neoclassical perspective, the increase in productivity generates economic growth through several channels such as a direct increase in aggregate supply, a rise in international ability to compete, and an increase in opportunities for investment. In this dissertation we make use of both the demand and supply perspective and, specifically, model this dual feedback mechanism that exists between output growth and labor productivity growth.

Additionally, the literature on growth has long debated one other factor that can stimulate the process of economic development, namely the distribution of income. The debate is whether or not economies characterized by a more equal distribution of income do indeed have better economic performance than countries with high income concentration. In this case, the relationship between equality and economic growth becomes important. We can divide the debate in terms of empirical evidence and theoretical arguments.

Let us begin with the classical arguments about the evolution of economies. Ricardo (and Marx) argues that there is, in the long run, an inverse relationship between real wage and profit rate. Conflict among different social classes is a common factor in different economies. Assuming fixed wages in terms of corn, he uses his corn-model to

[3]For empirical evidence of KV Law see Marinho et al. (1998).

show that profits are the residual. Diminishing returns in agriculture explain why redistribution in favor of workers leads to stagnation. Higher wages are translated into higher demand for corn, which forces the use of the marginal land, increasing the landlord's rent in the productive land. In this context, the share of profit in the total surplus declines and the economy stagnates. Tax increases and market protection against foreign goods leads to the same result. Because of this negative association, the redistribution of income leads to a deterioration of profit rates. This result is based in two assumptions: the existence of a fixed utilization rate and no independent investment function (Blecker 1989). Using the standard commodity approach, Sraffa supports the Ricardian result that there is a negative and linear relationship between wages and profit rates.

In contrast, Kalecki (1971) argues that there is a different association in the long-run. He assumes that economies present an excess of capacity utilization. The rate of utilization of capacity is endogenous in the long run. Additionally, firms present a horizontal marginal cost up to full capacity. In this context, the redistribution of income leads to higher demand that generates higher output and investment. In conclusion, there is a positive relationship between the real wage and the profit rate in the long run.

A theoretical model based on Kalecki's theory is presented by Dutt (1984). He presents a model that describes the relation between growth and income distribution for India. His result (a positive relation between growth and distribution) goes against the standard economic development literature based on some variations of the Cambridge equation. The standard argument is the following: the higher the output growth, the higher the requirement for accumulation, which, consequently, depends on savings so that to sustain output expansion it is necessary to redistribute income toward higher savers

(capitalists). Those models assume that the economy is at full capacity utilization. Once we assume excess capacity, Dutt's theoretical model exhibits that for India it is possible and, actually required to redistribute income toward labor to generate output growth. He states that an insufficient demand level is central to explain the stagnation of the Indian economy during the 1960s and 1970s. In this context, redistributive fiscal policies may generate economic growth with equality. Taylor (1985) goes in the same direction, presenting a stagnationist model.

An important qualification for the stagnationist model is presented by Blecker (1989). He argues that under some conditions economies tend to present an inverse relationship between wages and profits. In the context of an open economy, firms take into consideration foreign competition before setting their mark-ups. In this sense, mark-ups are strategically set to gain international competitiviness and penetrate foreign markets. If this argument is valid, a redistribution of income toward labor leads to a profit squeeze since firms cannot pass increased costs to final consumers. In other words, any increase in final prices, as a result of higher labor costs, is translated into smaller domestic and international market-shares.

There is some empirical evidence against redistribution of income for some areas (parts) of Brazil. Berni et al. (2002) and Bagolin et al. (2003) found support for the Kuznets' curve for the south region using weighted local regression and panel data, respectively. Kuznets' proposition is that economic growth might lead to equality in the long run. In this regard, the Kuznets' curve was empirical evidence that for a long time challenged the proposition that inequality hurts growth. The Kuznets' U inverted curve established strong empirical evidence that in the middle stages of development inequality

is required and natural. It is a natural consequence of the process of economic growth, while in the long run the equality of income will predominate. The argument is that the increasing size of industry generates a raise in productivity for this sector that leads to an increase in the remuneration for skilled labor. The scarcity of skilled labor and capital leads to an increase in their remuneration in the initial and middle stages of development. With time, skilled labor becomes abundant and consequently its remuneration decreases and as a result there is an improvement of the degree of equality.

The treatment of inequality in a two-dimensional basis, albeit relevant in some cases, can be problematic. In this way, theoretical arguments in favor of equality should be incorporated into the analysis. If income redistribution toward labor leads to improvement in education and health, it will generate also economic growth because labor productivity is positive correlated with education and health in the long term. The redistribution of income toward the poor improves population health if the relationship between absolute income and health status is concave (Deaton 2003). In this way, redistribution will push the population out of the poverty line. As a result, this measure will improve health and education. The effects of the improvement of health and education indicators will stimulate economic growth in the long run. Besides, a wage-led[4] economy can achieve economic prosperity through redistributive policies.

Another important argument in favor of equality concerns the role of savings as a constraint to economic expansion. Ros (2000) points out that because developing open economies might not be constrained from finance investment, the standard argument that redistribution against high savers will generate slow economic growth may be wrong. The

[4]A situation in which the investment grows less than savings when there is an increase in profit share.

level of access to foreign savings tends to vary positively with the level of development. Even if the level of domestic savings does not impose a limit on economic expansion for a subgroup of developing countries, redistribution toward the poor may improve development through several channels, such as reducing political instability or relaxing credit constraints for the poor who would then be able to pursue better education. The former can induce additional innovations and investment while the latter might improve productivity through accumulation of human capital. Moreover, redistribution can increase the size of the domestic market, generating substantial economies of scale. The reduction of political instability can benefit institutional reforms and benefit the provision of public goods in a way that makes political agreements easier to achieve. Ros (2000) also suggests that inequality may provide incentives for key economic agents to pursue rent-seeking activities.

The same theoretical results can be underpinned in a microeconomic level. Using the utility approach, we can say that if we unwind the assumption of exogenous preferences, distribution of income may maximize the aggregate utility. If the utility of an individual is a function of the well-being of other individuals in the community, then the redistribution of income from the rich to the poor may generate a higher level of aggregate utility because the rise in the utility of the lower and middle classes more than compensate the loss of utility of the upper class. In contrast, income concentration would function in a perverse way. It seems that the utility of one individual may increase when another individual gains a minimum amount of goods. Redistribution can be justified if preferences are endogenous and interrelated. In spite of some theoretical benefits, the microeconomic analysis fails to capture the interaction process among different sectors.

Turning now to the sectoral level of analysis, fix-flex price models attempt to explain how a dual economy responds to exogenous shocks. These models may include two sectors that behave in a different fashion. One sector, typically, clears by changes in prices; hence, supply-constrained. In contrast, the other sector clears through changes in quantities; hence, demand-constrained. Depending on the closure adopted, the model may generate different results, e.g., if a Keynesian closure is used, demand shocks generate output expansion. Investment triggers consumption and output expansion. In this scenario, causality runs from investment to savings, and the redistribution of income toward labor leads to a rise in economic activity.

However, a common closure to fix-flex price model is the forced savings, which generates different results. The redistribution of income to labor triggers consumption and inflation, which decrease real wages. It assumes that the economy is located at full capacity. In summary, the type of closure used is of fundamental importance in terms of the results to be achieved. The closure to be adopted should be based on the economic reality of the region.

The above arguments, therefore, have shown that the relationship between equality and economic growth is complex. The inequality of income can have different sources, and it is important to find out which factor is dominant in its explanation. If the increase in levels of education and health offsets the effects of reducing domestic savings, then the redistribution of income will be a required policy to generate economic development. It is also important to consider inequality in a broad sense including political inequality, income inequality, land inequality, etc. The next section introduces some background on the Brazilian economy to show that inequality might be a strong constraint to Brazil's

economic development.

1.3 Brazilian Historical Background

The Brazilian economy has performed rather poorly since the 1980s. The average annual real growth rate was 2.66 percent, but if we consider the average annual real growth rate per capita the results are, of course, less severe. Starting in the 1980s, many economists and policy makers believed that South American countries had previously chosen the wrong development model. The well-known model of industrialization through substitution of imports was adopted by many South American countries during the 30s. The strategy was to protect the domestic market against external competition. The main goal was to promote industrialization through exchange rate controls and subsidies for key economic sectors. This model worked relatively well until the 1970s; however, the oil shocks of 1973 and 1979, the debt crisis of the 1980s, and the lack of resources necessary to produce industrial goods were some factors responsible for the abandonment of this development model. In this context, two main views about the Brazilian economic model were predominant to explain its limitations during the 50s and 60s. Let us begin with Furtado's views about the limitations of the model of industrialization through substitution of imports. Latter, we will present the arguments from Tavares and Serra (1977) and the neoliberal model that took place during the 90s.

Furtado (1965) argues that there was a tendency toward economic stagnation in economies that tried to develop through Substitutive Industrialization.[5] According to his analysis (1965, p.159), there are two main stylized facts: a tendency to slowdown in real

[5]Substitutive Industrialization is the term that Furtado uses to refer to a plan of industrialization based in domestic markets followed by a persistent decline in the coefficient of imports.

activity and a persistent pressure toward a rise in prices. He considers the process of capital formation a crucial element for understanding the pattern of development of the Brazilian economy.

The Industrialization phase is the turning point where the forces that lead to stagnation and inflation dominate. The change in the international market conditions led the government to respond with a counter-cyclical policy. It was implemented to support the export sector. The decrease in exports was followed by exchange rate depreciation, an increase in credit, and a rise in the tariff level. As a result, there was a change in the cost structure and, consequently, a dispute between classes to keep their income protected against inflation.

The price of industrial goods is expected to rise after tariff protections, which redirects investment toward the industrial sector. This sector has low capital productivity and its performance depends heavily on the size of the domestic market. In this way, the movement of economic resources towards a sector with high capital-labor ratio and depressed wages, since wage is socially determined by the subsistence sector, generates a high concentration of income. The concentration of income, on the other hand, causes a negative impact in the allocation of investment. At the same time, a decline in the transfer of labor from the subsistence sector toward modern activities has a further negative effect in the economy. The perverse dynamics of this model[6] are related to the fact that the decline in the agricultural investment dominates the increase in the accumulation in the industrial sector; hence, the capital productivity of the economy drops. In conclusion, the concentration of investment in a sector that absorbs a small quantity of labor leads to a

[6]Taylor and Bacha (1975) present an interesting formal version of the Furtado's theoretical model.

perverse resource allocation that increases economic duality.

Although Furtado's arguments were relevant, some critics understood the process of development in the Brazilian economy in a different way. According to Tavares and Serra (1977), there was no imminent tendency toward stagnation in the Brazilian economy. They point out that the crisis in the 1960s represented simply a transition to a new phase of development. The previous model could not provide the stimulus needed to boost growth.

In this way, Tavares and Serra (1977) argue that Furtado's results are based on unreal (false) assumptions such as the equalization of the profit rate among subsectors of industry and wages are determined by the subsistence sector. Other factors such as the diffusion of technology and external economies could stop a possible trend toward decline in the output-capital ratio. Tavares and Serra (1977, p. 164) point out that there is no tendency toward equalization in the profit rate since imperfect markets are common in developing economies.

They suggest, on the other hand, that the explanation for the crisis of the 1960s was related to the decline of the investment rate. The tendency toward a realization crisis in the Brazilian economy demanded several arrangements to guarantee new sources of finance to boost investment. The strong decline of unskilled wages and the re-concentration of income were the mechanisms adopted to provide sources for new investment and demand expansion since old mechanisms that provided resources for investment such as inflation, exchange rate policy, and public loan policy were not present. In conclusion, Tavares and Serra (1977) do not believe in an imminent tendency toward stagnation, but instead, they claim that the model, by its own dynamic, creates several constraints that demand new social, economic, and political arrangements.

The Industrialization for Substitution of Imports model (ISI) was replaced by a heterogeneous model in the early 80s, and around the mid-80s Brazil started its process of economic liberalization. The abandonment of the ISI model was followed by profound criticism. The main shortcoming emphasized by the critics of the old model was that industrialization would solve the historical problem of income inequality.

Tables 1, 2, 3, and 4 show some key economic indicators of the Brazilian economy. Almost all the economic indicators show that the economic situation of the 90s was the worst Brazil had experienced in 30 years. Table 1 shows that average GDP growth rate during the 90s was even worse than the previous decade (1980-89), which was called the lost decade. Indicators such as the Gini index of concentration revealed a slight improvement in the 90s. The period was characterized by the profound intensification of neoliberal policies.

The next decade presented some improvements in the economic indicators. Table 4 shows that there was a decline in the degree of informality in the Brazilian economy. It was 54.3 percent in 2000 and dropped to 50.7 percent in 2007, which shows a modest but important recovery. One of the possible reasons for the equality improvement might be the conditional cash transfer program called Bolsa Familia that provides financial support for poor families. This program redistributes income for people situated in the informal sector may have contributed to the improvement in the Gini coefficient. In 2009, this program benefited 12,370,915 families, which compared to the 2004 numbers (6,571,839 families) represents an increase of 14.38 percent (IPEA 2010). Furthermore, Table 2 shows better numbers for income inequality, as measured by the Gini index, after 2000. It seems that redistributive policy combined with economic expansion in the period may have positively

impacted the economy.

Figures 1 and 2 exhibit the wage share and social spending as a percentage of GDP, respectively. Figure 1 shows a downward trend in the wage share between 1995 and mid 2000s. This persistent decline is interrupted in 2004, which represents the turning point where the wage share starts to grow again. The intensification of distributive policies in an attempt to fight poverty and inequality, together with an economic model that has focused on job creation are the defining features of the Brazilian economy during the 2000s.

Turning now to Figure 2, we detect that social spending increases during the 2000s. Social expenditure includes the government spending in social transfers, eduction, culture, health, social security, and housing. This positive trend on social spending with respect to GDP revelas a possible positive effect on output expansion.

In conclusion, the Brazilian economy's performance in the 1990s was a result of the adoption of a neoliberal economic model and negative external shocks. Redistribution of income may foster short-term economic expansion if the accelerator is the most important factor to explain the increase in the investment level. In other words, income redistribution is a sufficient condition for development if and only if the Brazilian economy is demand-led. A progressive policy that combines the creation of jobs with social policies, through its impact in aggregate demand, may be an important source of economic growth. Indeed, the positive economic statistics in the 2000s are the result of an implemented policy with focus on social policies and generation of formal jobs (International Labour Organization (ILO) Report (2011)). As the Great Recession (2007-2009) unfolded, the Brazilian economy was capable to present a fast recovery.

1.4 Duality and the Structuralist Model

The structuralist model is influenced (affected) by a combination of economic ideas proposed by major economists. Contributions from Lewis (1954), Prebisch (1959), Keynes (1936), Kalecki (1971), and Leontief (1983) are the foundation of the Structuralist model. To understand this model in its complete extensions and implications, it is important to first briefly review the main propositions of these great economists to further examine the functioning of the structuralist model and how it incorporates different theories.

Let us begin with the review of some important contributions from Lewis (1954). His well-known work titled `Economic Development with Unlimited Supplies of Labor' represents the beginning of the incorporation of economic duality into formal development economic models. The model has two sectors that behave in different fashion. The traditional sector, made up of subsistence activities such as peasant agriculture, provides unlimited supply of labor to the capitalist sector. In classical fashion, wages are socially or institutionally determined. The traditional sector presents low labor productivity, and labor is considered redundant.

In contrast, the capitalist sector presents high labor productivity. The capitalist sector is the engine of economic growth. During expansion, capitalist' sector output increases, absorbing higher amounts of labor from the traditional sector. In this model, capitalist profits are automatically reinvested. The transfer of workers from the traditional sector, a low labor productivity sector, to the modern sector, a high labor productivity sector, leads to a rise in average labor productivity in the whole economy. With a higher capital-labor ratio and access to capital, the capitalist sector can make any transferred worker more productive. The exhaustion of surplus labor in the traditional sector

represents the transition from a surplus labor economy to a scarce one. Wages increase as a consequence of labor scarcity. As a result, an economy with an integrated labor market emerges (Levitt 2005). In sum, dropping the assumption of a full employment economy, Lewis (1954) was able to describe the economic process in developing economies.

Lewis' theory, therefore, provides important insights about the expansionary process of a dual economy. A well-known stylized fact is the high association between degree of industrialization and the level of per capita income (Jorgenson 1967). In this sense, governments in developing economies should pursue industrial policy jointly with policies that attempt to improve the labor productivity of the traditional sector. This strategy is required to achieve economic development. The idea of distinct sectors that behave in different fashion is central to structuralist models.

Using a different approach, Prebisch (1959) reaches the same basic conclusion. Industrialization is seen as the only strategy toward development and independence. There is a duality between developed, the center, and developing economies (the periphery). In the center, we have a homogeneous structural base where there is no much discrepancy among sectoral labor productivities, whereas, in the periphery, the structural heterogeneity is predominant. In the latter, exports of agricultural goods is the main source of output expansion. In these economies, there is no robust process of technology innovation. In contrast, the center is the responsible for creating new technology. In this sense, the center presents, in terms of labor and commodity markets, a monopolistic structure, while the periphery resembles a competitive market.

This structural difference is crucial to explain the periphery dependency and its unfavorable terms of trade. In the periphery, labor productivity gains are translated into

lower export prices, which benefit the center. The decline in export prices occurs because the labor is not unionized in the periphery; whereas, workers are unionized and resist against wage reductions in the center. Conversely, in the center, productivity gains are reflected into reduction in costs without a fall in final prices. In this context, wages and profits increase, which stimulates domestic demand and, consequently, causes output expansion. As a result, there is a tendency for the terms of trade of the periphery to deteriorate over time since prices in the center are constant and prices of primary goods decrease in the periphery.

Alternatively, using a demand side analysis, we reach the same result. Terms of trade deteriorate in the periphery because of the specialization in goods with low income elasticity. It means that the demand for agricultural goods from the periphery grows slowly with the income expansion in the center. In the periphery, when income rises, the manufacturing-consumption ratio tends to increase. This increase is translated into higher manufacturing demand, which leads to higher manufacturing prices and, finally, to a trade deficit in the periphery. In contrast, the rise in income in the center leads to a reduction in the primary imports-consumption ratio, which tends to reduce primary goods' prices. As a result, we have a positive impact in the balance of payments of the center.

In summary, to avoid balance of payment problems, developing countries should try to industrialize their economies. The import substitution strategy should be employed to pursue industrialization. In this sense, comparative advantage is endogenous. Structuralist models use the Prebisch's insights in models that describe the trade interdependency between north and south.

With respect to Keynes' contributions incorporated into the structuralist

framework, one is of crucial importance. Keynes challenged the Say's Law in his masterpiece `The General Theory of Employment, Interest and Money.' Abstracting from rudimentary economies, which present a direct link between savings and investment, the Say's Law does not hold empirically. Using the Marxian approach, we may argue that Say's Law works in the C-M-C' but not in M-C-M' societies.

His experience during the great depression convinced him that an economy tends to a stable equilibrium position characterized by unemployment. In this vein, the effective demand would explain how expansion creates the necessary savings to match the rise in investment. In this context, an increase in the investment demand leads to a change in income that will generate a change in savings in equal amount to the rise in investment. The multiplier effect is important for explaining the process of adjustment of income in the level where savings are equal to investment. In this way, the causality runs from investment to savings, not vice-versa. His efforts to provide a systematic way to deal with national accounting statistics and aggregates are worth mentioning. In conclusion, the idea that economies tend to function at a lower than full employment position is credited to Keynes. This important accomplishment is incorporated into structuralist models.

The Polish economist Michael Kalecki is perhaps the major influence on structuralist models. He developed a theory with similar conclusions but not employing the Marshalian approach. He uses an oligopolistic framework. In this scenario, the firm's marginal cost functions are horizontal up to full capacity. As a result, increases in demand are not translated into price increases. Firms set prices using a mark-up over costs.

The idea of paradox costs where wage increases lead the economy into an expansion is important to explain cooperative regimes. In classical fashion, capitalists do

not consume in this model. The paradox is present in the fact that it is not beneficial for the individual capitalist to raise the wages of its employees, but if the capitalist class as a whole provides wage increases to workers, the total output and profits will rise.

The notion of an economy below full capacity is crucial to Kalecki. In some models that follow this tradition, the rate of utilization of capacity is endogenous. A functional distribution of income toward labor triggers aggregate consumption, generating a surge in aggregate output. However, the process does not stop there. The incorporation of an independent investment function that incorporates the accelerator and the effect of profits on investment into the model allows for an even stronger process of expansion without significant inflationary pressures. In this scenario, increases in real wage leads to higher rates of capacity utilization (Lavoie 1995). The inclusion of this independent function was first formalized by Steindl (1952). As a result, Kalecki's theory allows for a positive relationship between profit rate and real wage rate in the long run, an unusual result for classical and neoclassical economists. The independent investment demand function is an important component of many structuralist models.

Finally, Leontief's Input-Output approach provided the required analytical tool (instrument) to measure the interrelation between sectors and the aggregate economic activity. Using Leontief's approach, structuralists are able to produce consistent input-output tables, allowing them to pursue simulation experiments.

To summarize, structuralists use the above contributions of different economists to build their models. From Lewis, they employ the concept of a dual economy in which sectors function in different ways. The external dimension, exports and imports functions, is greatly influenced by Prebisch. Structuralist north-south models, employed to describe

the inter-relationship among countries in the periphery and center, usually take into consideration the unfavorable terms of trade conditions. Keynes' ideas (the multiplier, the effective demand and, principally, the inadequacy of Say's Law) are incorporated in every structuralist model. Finally, Kalecki's model might represent the most important influence in structuralist modeling. The mark-up theory of prices, the paradox of costs, and the independent investment demand function are present in every structuralist model.

In this sense, Taylor's works are important because they represent the typical model that incorporates the features above described. His studies are the starting point where Structuralist Computable models are used. Structuralist Computable (or calibrated) models consider the structure of the economy and its institutions as important factors to explain the evolution of economic systems. It considers social classes instead of individual behavior; the model usually presents a Keynesian closure. In this context, it is important to show the basic structure of the model.

The simplest version of the one-good one-sector short-run model (closed economy with no intermediates and no government) is presented below. First, the oligopolistic structure of the industrial sector implies that firms set prices using a mark-up rule. The price setting process is represented as follows:

$$P = (1+\gamma)wb \tag{1.1}$$

where γ, P, w, and b, stand, respectively, for the mark-up, prices, individual nominal wage, and labor-output ratio. As argued before, this is one of the Kalecki's contribution incorporated into the structuralist model.

There are only two classes: capitalists and workers. Their income equations are shown below:

$$Y_c = \pi X \tag{1.2}$$

$$Y_w = wL \tag{1.3}$$

where Y_c, X, and Y_w are, respectively, capitalist income, total output and workers' income. L is the total amount of labor.

Second, it is assumed that the economy is located in a position below full capacity. The equation below represents the sectoral balance.

$$C_w + C_c + I - X = 0 \tag{1.4}$$

where C_c and C_w are, respectively, capitalist consumption and workers' consumption. The variable 'I' is the investment level.

To close the model, we need to add some additional equations. Let us start with consumption. Workers consume the major part of the output in this simple model. In this way, the consumption equations are the following:

$$C_c = \frac{(1-s_c)\pi X}{P} \tag{1.5}$$

$$C_w = \frac{(1-s_w)wL}{P} \tag{1.6}$$

where s_c and s_w stand, respectively, for the marginal propensity of capitalists and workers to save.

Turning now to investment, an independent investment function, a la Kalecki, is employed.

$$I = z_0 + z_1 \pi X + z_2 X \tag{1.7}$$

where z_0, z_1, and z_2, stand, respectively, for animal spirits (from Keynes), the effect of profits on investment and the accelerator.

Combining the above equations with the savings generating process allow us to close the model. The savings equations are below:

$$S_c = s_w wL \tag{1.8}$$

$$S_c = s_c \pi X \tag{1.9}$$

where S_c is capitalist savings and S_w is worker's savings.

Finally, setting the equilibrium condition as savings equal to investment closes the model.

$$S = S_c + S_w = PI \tag{1.10}$$

Using the above equations and assuming a Keynesian closure, we find the saving-investment balance:

$$s_w wL + s_c \pi X - P(z_0 + z_1 \pi X + z_2 X) = 0 \tag{1.11}$$

Total saving is the sum of saving out of profits and saving out of wages. The closure of the model is Keynesian, that is, investment is triggered by changes in output. The investment level rises in response to a change in aggregate demand.

An increase in wages generates the following results.[7] We can detect the adjustment process using the saving-investment balance equation. The investment function, eq. (7) , reveals the investment demand, while equations (8) and (9) stand for the saving supply.

There are three major effects. First, since s_c is higher than s_w, the rise in wages leads to an increase in aggregate demand. The increased aggregate demand triggers outputs expansion.

The second effect is related to a change in investment demand. Empirically, the coefficient z_2 in eq. (11) is higher than z_1. According to Taylor (1983), this econometric result holds for many developing countries. The investment demand increases, leading to further increases in output. In this way, capitalists will react to an increase in the output

[7] If extended to the long run, there are two major critics to the model. First, Skott (2009) argues that there is no empirical evidence for the Kaleckian investment function. Second, the notion of normal rates of capacity utilization is not convincing for neo-Ricardians and neo-Marxists (Lavoie 1995).

level, X, by adjusting their investment level, I.

Finally, an increase in saving supply follows a rise in real activity, X, at a given profit level. In this sense, the saving supply accommodates the increase in investment through the rise in output. The effect of an increase in wages is therefore higher investment, output (X), and profits. This is exactly expressed in the paradox of costs.

The structuralist model, therefore, uses the contributions from classical economists, Keynes, Kalecki, and Lewis to set models to describe and study the evolution process of developing economies. In the next section, we introduce the two-sector model, which describes the Brazilian economy.

1.5 The Structuralist Model for the Brazilian Economy

The model describes an open developing economy with two sectors (formal and informal), two commodities (tradable and nontradable), and three classes (capitalists, formal labor, and informal labor). There is no unemployment. Everyone who wants to work can find an informal job in the informal sector. The model abstracts from financial market and government activities.

Following Lewis, the two sectors behave in different fashion. The subsistence sector is supply-constrained. This sector operates at full capacity, hence it is a price clearing sector. The labor remuneration in this sector is a positive function of its labor productivity. In this context, there is no clear distinction between labor and capital in this sector.

By contrast, the modern sector is a quantity-clearing sector, hence demand-constrained. In other words, this sector operates with excess capacity. Output in

the modern sector is supposed to change to accommodate disturbances in other variables. In Kaleckian fashion, the modern sector price is set according to a mark-up rule over costs. Notice that capital stock is present only in the modern sector. The migration of workers from the subsistence sector, a low labor productivity sector, to the modern sector, a high labor productivity sector, leads to a rise in average labor productivity in the whole economy. Because the modern sector contains a higher capital-labor ratio, it can make any transferred worker more productive.

From Kalecki and its colleague Steindl, the model incorporates an independent investment function. This function has three components: animal spirits, the effect of profits on investment, and the accelerator.

Turning now to the external side, the model includes exports and imports as endogenous variables. Exports respond to price changes and external demand, while imports respond to prices and output.

Finally, the closure of the model is Keynesian. The causality runs from investment to savings, not vice-versa. In this way, an exogenous investment shock leads to a rise in output that feeds back, through the accelerator, into higher investment, expanding further the output. The rise in output generates a higher amount of profits and, consequently, increasing savings. In this context, an increase in the investment demand leads to a change in income that will generate a change in savings enough to match the rise in investment.

The model presented is standard (Taylor 1983). The model incorporates the contributions of the economists introduced in the previous section. We use the dual model, in the short run, to compare the effects of four experiments: an income transfer toward workers in the modern sector, an income transfer toward workers from the subsistence

sector, an investment shock, and an exchange rate shock.

Therefore, the model introduced in this section resembles all the features of a typical structuralist model. It contains two sectors that function differently, an independent investment function, and, finally, a Keynesian closure. In this sense, structuralist models that take into consideration issues such as the role of institutions, class conflict, and history to explain the evolution of the capitalist system, present an important advantage in terms of explicative power.

1.6 Conclusion

This paper has introduced a brief review on the relationship between distribution of income and economic expansion. It also introduced a brief historical background of the Brazilian economy and the structuralist model. The above sections suggest the following points.

First, the relationship between equality and economic growth is complex. Inequality of income can have different sources and it is important to find out which factor is dominant in its explanation. If the increase in levels of education and health offsets the effects of reducing domestic savings, then redistribution of income will be a required policy to generate economic development.

Second, the Brazilian's economic performance in the 1990s may be considered a function of the adoption of neoliberal policies and external shocks. If and only if the Brazilian economy is wage-led, income redistribution might be a sufficient condition for development.

Finally, the structuralist model might be employed to study the functioning of

developing economies. This model uses the contributions from different economists to build models to describe and study the economic evolution process. The model introduced for the Brazilian economy resembles all the features of a typical structuralist model. Comparing to other economic models, they may present an important advantage in terms of explicative power.

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Table 1

Average GDP growth rate for Brazil during 1970-2009.

	1970-79	1980-89	1990-99	2000-09
Brazil	8.789	3.022	1.645	3.33

Source: Instituto de Pesquisa Econômica Aplicada (IPEA).

Table 2

Inequality in Brazil (Gini index), 1985-2009.

	1990	1995	2001	2005	2009
Brazil	0.614	0.601	0.596	0.569	0.543

Source: Instituto de Pesquisa Econômica Aplicada (IPEA).

Table 3

Land distribution in Brazil, 1967-2000.

	1967	1972	1978	1992	1998	2000
Brazil	0.836	0.837	0.854	0.831	0.843	0.802

Source: Instituto Nacional de Colonização e Reforma Agraria (INCRA).

Table 4

Informality in Brazil (percentages), 2003-2007.

	2003	2004	2005	2006	2007
Brazil	54.3	53.7	52.9	52	50.7

Source: Instituto de Pesquisa Econômica Aplicada (IPEA).

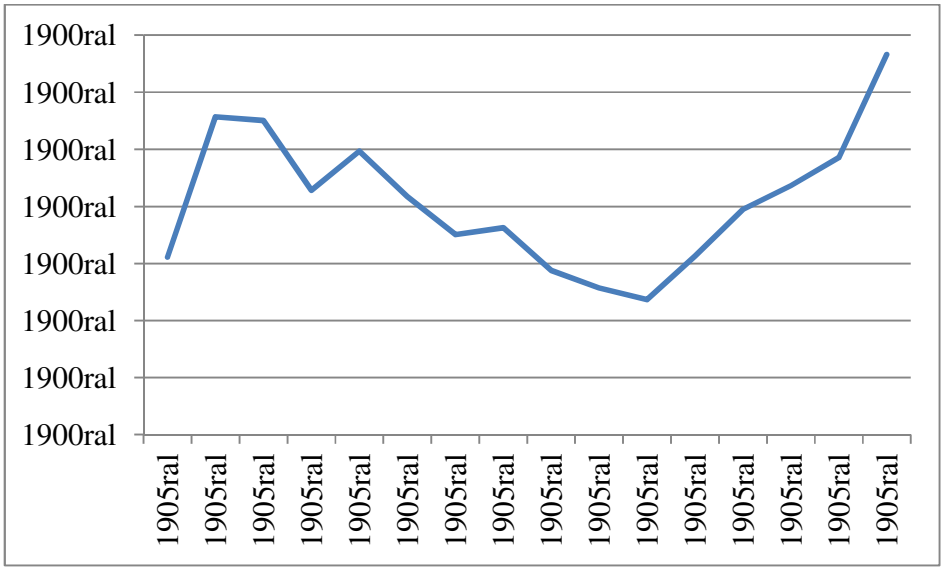

Figure 1: Wage share (% of GDP).
Source: Instituto Brasileiro de Geografia e Estatística (IBGE).

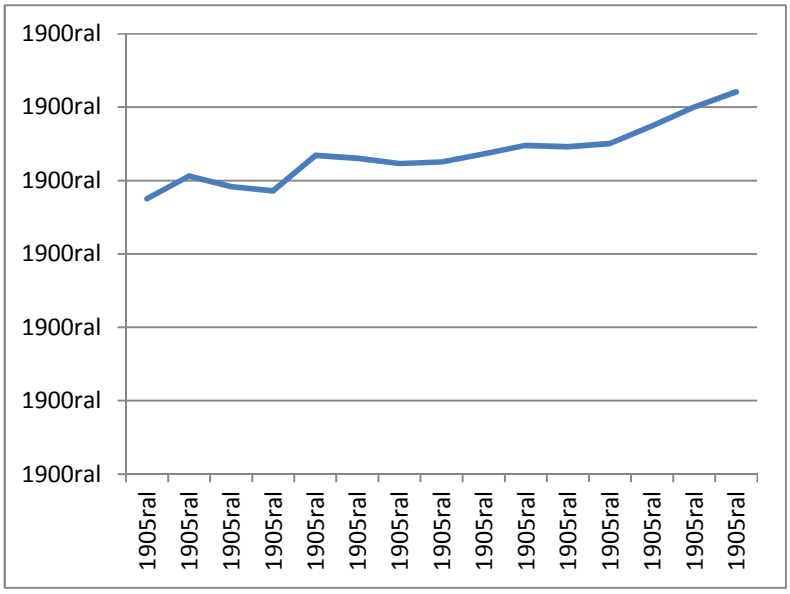

Figure 2: Social spending (% of GDP).
Source: Economic Commission for Latin America & the Caribbean (ECLAC).

CHAPTER 2

FORMAL AND INFORMAL SECTORS IN A SOCIAL ACCOUNTING MATRIX FOR BRAZIL

2.1 Introduction

One of the increasing concerns in economic development is the measurement of the informal sector in developing economies and its interaction with the formal sector along the cumulative process of growth. Economists agree that in many low- and middle-income countries, the informal sector is a key player as a provider of jobs and a source of labor surplus in periods of rapid output expansion. Moreover, in the 1990s, stylized facts highlight that there is an increase in the share of the informal sector during economic expansion in many developing countries (Rada 2010). This phenomenon, known as jobless growth, is present in some developing countries such as India, China and in parts of South America.

Because of the critical role of the informal sector in developing economies, it is important to estimate the size of this sector and its relationship with the formal sector as a tool to understand the complexities of the process of economic expansion and to support future economic policy. Policies that try to reduce poverty and promote economic growth must be based on a profound understanding of the economic structure. The lack of reliable statistical data, however, is a significant constraint to achieving a consistent estimation of

the social accounting matrix.

The purpose of this chapter is to present the methodology to estimate a Social Accounting Matrix (SAM) that differentiates between formal and informal sectors for Brazil in 2006. The primary source of data used in this dissertation is the national accounting statistics for 2006. Use and resources tables were used to build the Input-Output (I-O) table and, consequently, the SAM, in addition to supplementary information from the integrated economic accounts (flow of funds table) for the same year. This chapter considers the informal sector to be made up of firms that are not officially registered with government of Brazil; the informal sector is defined as unorganized activities that present low labor productivity.

There are three main contributions of this chapter: First, to present a methodology to build the input-output matrix that combines some elements presented in Guilhoto (1999) and Grijo and Berni (2006); second, to reveal the structural linkages between the two sectors; third, to offer an estimation of the social accounting matrix that incorporates both formal and informal sectors, serving as a data input for future Structuralist Calibrated models.[1]

This chapter is organized as follows. First, after this brief introduction, the basic procedures to harmonize the national accounting tables are presented. Then, the steps of constructing the SAM and its results are documented and analyzed in Section 2.3. Finally, the last section is reserved for conclusion. The tables used in constructing the Brazilian SAM appear in the appendix.

[1]Structuralist computable (or calibrated) models consider the structure of the economy and its institutions as important factors to explain the evolution of economic systems. It considers social classes instead of individual behavior; the model usually presents a Keynesian closure. The main reference is Taylor (1983).

2.2 The Harmonization of National Statistical Accounts and Some Important Identities of the Leontief's Model

This section starts with the presentation of the procedure to harmonize the source of data to build a Social Accounting Matrix for Brazil for year 2006. The social accounting matrix provides a schematic behavior of the economy. It describes the circular flow of income inside the economy. The SAM is a union of an Input-Output (I-O) table, which describes the interindustry transactions in the economy, and the flow of funds among institutions. Another characteristic of the SAM is derived from national accounting where expenditure must be equal to income.

Furthermore, the SAM is a square matrix, a necessary condition to the existence of one solution. The columns of the matrix represent purchases while reading across the rows represents sales. The sum of each row must be equal to the sum of each column to guarantee the national accounting condition that income is equal to expenditure.

The SAM has four main building blocks: the input-output table, the use of output table (final demand table), the value-added table and the flow of funds table. In the upper west side of the SAM, the input-output table describes the transactions among economic activities. For example, the I-O table shows how much the manufacturing sector purchases from mining and quarrying. Next, in the upper east part of the SAM, we have the use of output table. This quadrant of the SAM includes five major components: the final consumption by households, government purchases, exports, capital formation and change in stocks. The total value of output being sold is the result of the addition of the input-output table to the final use of output (final demand) table. The quadrant below the input-output table provides the sectoral costs, excluding intermediate inputs, to produce the

output being sold. Finally, the flow of funds quadrant describes the transfers of income among institutions. This table presents five major institutions: families, government, financial enterprises, nonfinancial enterprises, and the rest of the world. The flow of funds table is the source of data to build the quadrant in the center of the SAM. Some of the entries in the center of the SAM are: transfer of income from government to workers, income from properties, rents, dividends and interest paid to workers, capital transfers, etc. Table 5 presents the schematic SAM for Brazil with the respective definition for each cell and the origin of the data. It is important to emphasize that all the identities[2] presented in the set of equations below (Footnote 2) were tested to guarantee that the results are accurate. For more details see Miller and Blair (1985) and Grijo and Berni (2006).

2

$$q \equiv Uni + fn \quad (2.1)$$
$$Bn \equiv Un(1/\hat{g}) \quad (2.2)$$
$$Un \equiv Bn\hat{g} \quad (2.3)$$
$$q \equiv Bng + fn \quad (2.4)$$
$$g \equiv Vi \quad (2.5)$$
$$D \equiv V/\hat{q} \quad (2.6)$$
$$V \equiv \hat{q} \quad (2.7)$$
$$g \equiv Dq \quad (2.8)$$
$$g \equiv D(Bng + fn) \quad (2.9)$$
$$g \equiv DBng + Dfn \quad (2.10)$$
$$g \equiv (1/(I - DBn))Dfn \quad (2.11)$$

Where:
V : make matrix;
Un : use matrix;
D : market-share matrix;
Bn : technical coefficient matrix of domestic production;
fn : final demand vector;
q : gross production value per good;
$\hat{q}$:gross production value per good times an identity matrix;
g : gross production value per activity;
$\hat{g}$: gross production value per activity times an identity matrix.

The problem of harmonizing different tables of the national statistical data is derived from the fact that the two major tables (use[3] and make tables), that serve as the main source for the computation of the Input-Output table, are measured at different prices. To find the I-O table, the use and make tables were used. The former represents the demand conditions of the production whereas the latter has the focus on the supply. In other words, the use table shows the intermediate use of output. Because the use table originally is measured at market prices, while the make table is estimated at basic prices, the problem to be solved is to convert the use matrix into basic prices.

The set of equations below represent the standard procedure to convert the use table into approximately basic prices. Use and make tables are released by the Brazilian Institute of Geography and Statistics (in Portuguese: Instituto Brasileiro de Geografia e Estatistica: IBGE) and can be found together in the Resources e Uses table (in Portuguese: Tabela de Recursos e Usos).

$$Sc \equiv Sb + CM + TM + T + M \tag{2.12}$$

$$FD \equiv X + G + K + C \tag{2.13}$$

$$TD \equiv DF + IC \tag{2.14}$$

$$TS \equiv TD \tag{2.15}$$

[3]Throughout this study the terms 'use table', 'intermediate use of output table', and 'intermediate inputs table' are used interchangeably.

$$Sb + CM + TM + T + M \equiv DF + IC \tag{2.16}$$

$$Db \equiv Sb \equiv DF + IC - CM - TM - T - M \tag{2.17}$$

where:

Sc : supply measured at consumer prices;

Sb : supply of domestic (national) activities measured at basic prices;

Db : demand measured at basic prices;

CM : transport margins;

TM : trade margins;

T : net taxes;

M : imports;

FD : final demand at consumer prices;

X : exports;

G : government purchases;

K : investment;

C : consumption;

TD : total demand at consumer prices;

IC : intermediate consumption or original use matrix;

TS : total supply at consumer prices.

According to the set of identities above, we may conclude that the solution needed would be to subtract the trade margins matrix, transport margins matrix, and tax and imports matrices from the supply at consumer prices, Sc, to find the supply of national

activities measured approximately at basic prices, Sb. Because supply is equivalent to demand, the two components of total demand, the intermediate use of output table (or use table) and the final demand table, might be converted into basic prices simply by a mathematic subtraction. This is exactly the procedure that was applied to convert the use table into basic prices.

The new intermediate use of output table at basic prices, therefore, will be the result of the subtraction of the trade margins matrix, transport margins matrix, and tax and imports matrices from the original intermediate use of output table, IC, estimated initially at market prices. In the next section, the procedure to estimate the tables is presented in more detail.

Before the complete considerations about the estimation process and its source of data are presented, it is important to reveal some of the basic assumptions of the model and its limitations. The basic limitations of the Leontief model are: the presence of constant returns to scale, the classification problem[4] expressed in the empirical fact that joint products[5] and by-products[6] do exist, and the common compromise that occurs every time the Brazilian National Statistical Office releases new data.

In particular, one of the limitations is important here. The classification problem presented in the early version of the Leontief model is solved through the pre-multiplication of the final demand vector and intersectoral impact matrix, Bn, by the market-share matrix, D. For instance, doing the market-share table times the use table (D x

[4]Problem related with the fact that the A matrix in Leontief's model is not a square matrix but instead it is a commodity by activity matrix. In other words, sectors actually produce and sell a variety of commodities.
[5]Two different goods produced simultaneously by the same productive process.
[6]Specific productive processes and chemical reactions of some economic activities may generate secondary commodities. These commodities are called by-products. For instance, methane gas (CH4) is a by-product of a chemical reaction that occurs on landfills.

Un) creates a sector by sector use matrix. In addition, the technology of the sector is assumed in order to obtain an activity by activity I-O matrix. That is, it assumes that a sector uses the same technology to produce all their goods.

The Input-Output table for Brazil is aggregated into 13 sectors.[7] Because we do not have the Input-Output table for 2006, the input-output table was derived from national accounting statistics for 2006. The Resources and Uses table provides the complete information needed to construct the I-O table. Furthermore, the data for the value-added table and use of output table also come from the Resources and Uses table. Lastly, the transfer of funds among institutions is derived from the flow of funds table (in Portuguese: Contas Economicas Integradas (CEI)). The same methodology developed by Grijo and Berni (2006) is used. In the next section, the steps to build the input-output table and other results are revealed.

2.3 The Complete Methodology to Estimate a Social Accounting Matrix for Brazil in 2006

This section describes the methodology used to estimate the SAM for Brazil in 2006. Subsection 3.1 explores the procedures to calculate the I-O table, including the estimation of the main matrices from the previous section. Subsection 3.2 presents the treatment to separate formal and informal sectors. Subsection 3.3 presents the two-sector SAM for Brazil. In the appendix, the procedures to calculate some entries of the flow of funds table, table that reveals the flow of income among institutions, are presented.

[7] These sectors are: agriculture, hunting, forestry and fishing; energy sector, mining and quarrying, manufacturing, public services, construction, wholesale and retail trade, transport and communication, information service, insurance, real estate, other services, and public administration.

2.3.1 From the National Statistical Accounts to the Input-Output Matrix

The methodology to estimate the input-output matrix follows the methodology developed by Guilhoto and Sesso (2002) to build an I-O matrix using national accounting data. According to this work, the tables presented in the previous section (the net tax, the imports, the import tax, the transport and trade margins tables) were estimated and deducted from both intermediate use of output and final demand tables. It was needed to convert these two tables into approximately basic prices. In this subsection, we present the procedure of estimation of these tables, including the I-O table. In this sense, the transport and trade margins tables are deducted exclusively from the use table (intermediate use of output table) while other important tables such as tax and imports matrices are deducted from both use and final demand matrices.

Using the Resources and Uses table,[8] the first challenge is to estimate matrices for the transport margins and trade margins vectors. These matrices must be built because the intermediate use of output table must be measured at basic prices. The procedure is the following. First, each cell of the original use matrix (intermediate use of output table), Un, should be divided by the gross production value per good, q (see Footnote 2). The result is a coefficient matrix. Then, multiply the trade and the transport margins vectors by the coefficient matrix to convert the vectors into matrices. Thereafter, subtract the new trade and transport matrices from the intermediate use of output (use) table. This procedure serves to distribute the margins into the intermediate use of output matrix. The assumption is that trade and transport margins are incident only in the input transactions among firms

[8]This table that initially contained 56 economic activities was aggregated into 13 sectors. These sectors are: agriculture, hunting, forestry and fishing; energy sector, mining and quarrying, manufacturing, public services, construction, wholesale and retail trade, transport and communication, information service, insurance, real estate, other services, and public administration. It is assumed that public services and public administration are two formal activities that do not employ informal labor.

and not in the final demand (see Tables 6 and 7).

The procedure to estimate the matrix for net taxes is the following. Each cell of the intermediate use of output table must be divided by the total demand vector. The outcome of this computation is a new coefficient matrix. This new matrix is multiplied by the vector of net taxes to convert it into matrix.

However, the remaining two matrices, imports and import tax matrices, are estimated differently. It is necessary to use a different approach because there is no incidence of imports and imports' taxes in at least one of the final demand components. Imports and imports' taxes should not be deducted from exports. To solve this problem, two specific coefficient matrices are calculated to spread both imports and imports' taxes vectors into the use and final demand matrices.

In this way, the coefficient matrix for the use table is calculated in two steps. First, the deduction of the exports from the total demand is necessary. Second, each cell of the use matrix is divided by the total demand vector (without exports) to get a coefficient matrix that later will be applied to spread imports and import tax into the use table. Then, the multiplication of the new coefficient matrix by imports and import tax vectors gives the imports and import tax matrices. In short, the five matrices (taxes, trade, transport, imports and imports' taxes) are deducted from the intermediate use of output table to convert this table into basic prices.

A Similar procedure is applied into the final demand matrix. More specifically, to estimate the tax matrix, each cell of the final demand matrix is divided by the total demand vector. Consequently, the multiplication of the tax vector by the resulting coefficient matrix produces the tax matrix.

For the same reasons explained previously, the procedure to estimate the remaining matrices is more complex. This time, the coefficient matrix for the final demand table is calculated in three steps. Firstly, the deduction of the exports from the total demand is again a necessity. Secondly, the new coefficient matrix must have the whole cells of the column of exports equal zero. Thirdly, each cell of the final demand matrix (deducted of exports) is divided by the total demand vector, a vector that does not include exports, to get a coefficient matrix to spread imports and imports' taxes into the final demand matrix. As a result, the simple multiplication of the coefficient matrix by imports and imports' taxes vectors creates the imports and imports' taxes matrices. For more details (results), see Tables 8-14.

The final demand matrix at approximately basic prices is the result of the final demand at market prices minus the tax matrix, the imports matrix, and the imports' taxes matrix. It is a standard procedure to transform the final demand components previously measured at market prices into basic prices. Table 15 shows the final demand matrix (sector by sector) at approximately basic prices. Furthermore, the components of the use of output part of the SAM (exports, household consumption, government purchases, and capital accumulation) are the result of these deductions.

The input-output matrix at approximately basic prices, therefore, is the result of the intermediate use of output table at market prices minus the tax matrix, the imports matrix, the import' tax matrix, trade matrix, and transport matrix. In the appendix (Section 2.6), one of the important components of the social accounting matrix is presented. Because the flow of funds table, table that measures the flow of income among institutions, is not directly available, an alternative procedure is implemented. Finally, Subsections 2.3.2 and 2.3.3

present the process of aggregation of the I-O Matrix and SAM, including the methodology that distinguishes between the formal and informal sectors.

2.3.2 Formal and Informal Activities in Brazil

In this study, the informal sector is defined as a subdivision of the household sector in the System of National Accounts - SNA, characterized by a particular way of organizing the production and an unclear division between labor and capital. This sector includes businesses that are not officially registered. Hallak et al. (2009) estimated the size of the informal sector for the aggregate economy and for ten sectors from 2000 to 2007. Informal labor has two main component parts: autonomous labor and employees without legal contract. Moreover, it is assumed that the informal sector uses only informal labor. To estimate a SAM that separates between formal and informal activities, the estimations by Hallak et al. (2009) are used. These estimations for the 10 sectors were disaggregated into 12 sectors following the procedures suggested by the Brazilian Institute of Geography and Statistics.

The statistics of value added for informal activities for the 12 major sectors in 2007 are used to estimate the shares of the informal and formal sectors in 2006. It is assumed that there is no significant structural change, in terms of the change in the size of the informal sector, between 2006 and 2007. Specifically for agriculture, wage shares for formal and informal sectors are being applied to separate each transaction into four entries. Equations 18 and 19, below, are applied to estimate the shares for the formal and informal sectors for 12 economic activities. The shares are presented below:

$$\varphi I = \frac{VAI}{VAI + VAF} \tag{2.18}$$

$$\varphi F = \frac{VAF}{VAI + VAF} \tag{2.19}$$

where φI, φF are the shares (weights) for the informal and formal sectors and VAI, VAF are the value added for the informal and formal sectors, respectively. In the appendix, Table 16 presents the 13 shares (weights) for formal and informal sectors.

Further, these sectoral shares of output are being used as weights to calculate the size of the informal sector. Each recorded transaction in the input-output table for the 13 activities will be separated into four entries. This methodology is based in Rada (2010). The four entries for the transaction of intermediate inputs, Xi, j, purchased by sector j from sector i are presented below:

Formal sector i - Formal sector j:

$$Xi, j - FF = Xi, j * \varphi F, i * \varphi F, j \tag{2.20}$$

Formal Sector i - Informal sector j:

$$Xi, j - FI = Xi, j * \varphi F, i * \varphi I, j \tag{2.21}$$

Informal sector i - Formal sector j:

$$Xi, j - IF = Xi, j * \varphi I, i * \varphi F, j \quad (2.22)$$

Informal sector i - Informal sector j:

$$Xi, j - II = Xi, j * \varphi I, i * \varphi I, j \quad (2.23)$$

Thereafter, we need to aggregate all the informal sector transactions into a unique informal sector. A similar procedure is adopted to aggregate the set of formal activities into a unique formal sector. The result is an input-output table, with only two major sectors, that distinguishes between formal and informal activities.

Slightly different procedure is adopted to separate every transaction in the use of output quadrant of the SAM. The process to separate households between formal and informal is different. For agriculture, this study uses the values of the wage share as weights to divide the consumption between formal and informal households.

To separate the aggregate consumption between the formal and informal for the other remaining sectors, the procedure adopted is to use the previous shares (Table 16), which separate the transactions of the I-O Matrix, and a new one that is the percentage of value-added for the economy as a whole. In this way, the share of the value-added for the formal sector is 78.36 percent, while the informal sector is 21.64 percent. That is, the formal sector represents 78.36 percent of the GDP. The equation below presents the procedure. For instance, the amount of consumption that the formal household, j, buys

from formal manufacturing, i, is the result of the following equation.

Formal sector i - Household j:

$$Ci, j - FF = Ci, j * \varphi F, i * \phi F \tag{2.24}$$

where ϕF is the index for the formal sector (78.36 percent) and $\varphi F, i$ is the value added share of the formal sector, in this case manufacturing, used previously as weights to separate informal and formal activities in the input-output table. A similar procedure is applied to separate the consumption between formal and informal households for the other 12 sectors. Thereafter, it is possible to aggregate in only two sectors and two consumers. The RAS technique, an algorithm used to balance square matrices, is applied to balance the sum of rows and columns of the SAM.

The use of output quadrant of the SAM has three additional components. First, exports are assumed to include formal activities only. The value of 315.24 billion reals represents exports of goods and services together. Next, government purchases are treated as expenditures on formal goods only. The value of 472.59 billion reals describes the government consumption for 2006. Finally, it is assumed that capital accumulation takes place only in the formal sector. The value of 397.03 billion reals, about 16.7 percent of GDP, reveals a low level of investment compared to other fast-growing emerging economies.

The quadrant below the input-output table provides the sectoral costs, excluding intermediate inputs, to produce the output being sold. In this quadrant, the wages of formal and informal labor are presented. Formal workers' remuneration comes directly from

national accounting statistics. This group includes the remuneration of employees with legal contracts such as civil servants, military workers, etc.

For informal workers, wages are the result of adding autonomous remuneration[9] to wages paid to workers in the informal sector. We assume that the informal sector does not employ formal workers. The value of 279.73 billion reals comes directly from national accounting statistics. Profits and wages are put together in the same entry because of the assumption that there is no clear differentiation between labor remuneration and profits for the informal sector. Conversely, for the formal sector, there are two distinct entries for profits and labor remuneration.

Another category of the sectoral costs is the imported inputs. Imported inputs are assumed to be concentrated into the formal sector, that is, only formal activities are capable to import inputs from the rest of the world. Lastly, government tax on production has incidence in the formal sector only. Table 5 shows that the origin of the data comes from the Resources and Uses table.

Turning now to the center of the SAM, the entries describe the transfers of funds among institutions. Because the Brazilian Statistical Office does not release directly the complete flow of funds table, we attempt to estimate the transfers of income among institutions indirectly. The Integrated Economic Accounts (in Portuguese: Contas Econômicas Integradas: CEI) provides the main information needed to a reliable estimation of these entries. This table presents five major institutions: families, government, financial enterprises, nonfinancial enterprises, and the rest of the world. Some of the entries in the center of the SAM are: transfer of income from government to workers,

[9]Autonomous remuneration consists in the remuneration of own-account workers and informal employers.

income from properties, rents, dividends and interest paid to workers, capital transfers, final goods imports, government and business transfers to the rest of the world, capital goods imports, etc.

There are two major assumptions concerning the numbers in the center of the SAM. First, transfers from government to households and transfer from capitalist to households are calculated endogenously.[10] Treating transfer as a residual is necessary because of the inconsistencies between different sources of data. The shares of value added for formal and informal activities are applied as weights to separate transfers between formal and informal workers. Second, informal households do not pay direct (income) tax.

Finally, government savings, capitalist savings, and household savings come from the same table (CEI) and the same code or transaction, B.12. Moreover, the current account result is derived from transaction B.12 (resources). The complete procedure to calculate the remaining entries is described in Appendix 2.6.

2.3.3 A Social Accounting Matrix for Brazil in 2006 that Includes Formal and Informal Sectors

The two-sector SAM for Brazil is presented in Table 17. The input-output table is located in the northwest corner of the SAM. Equations 20-23 were applied to calculate the input-output table. The formal sector provides inputs to the informal sector in the amount of 169.53 billion Brazilian reals (column B), and provides intermediate goods worth 1,334 billion reals to itself (column A).

Formal households purchase final goods from the formal sector in the amount of

[10]For instance, the government transfers toward labor is the result of subtracting government spending (excluding transfers) and savings from government revenue.

722.43 billion reals while informal households consume only 275.46 billion reals. Using the classical assumption that capitalist consumption is not significant, the capitalists' consumption is zero (column D).

The amount of 315.24 billion reals (column G) represents the demand from the rest of the world while investment goods (column H) are estimated at 348.53 billion reals. If compared to imports (row 7, column A), equivalent to 153.87 billion reals, the Brazilian economy has a trade surplus in the period. The total output (column I) for the formal sector is estimated at 3,637.89 billion reals. If we add the first row of the input-output table to the first row of the components of the final demand, the total output value can be calculated.

Turning now to the informal sector, similar interpretation can be made. Overall, this sector total output is estimated at 480.23 billion reals. Similar result can be found if we add the input-output table (column B) to the cost components (informal compensation). Informal labor compensation captures 279.73 billion reals of the informal sector's output.

Finally, the flow of funds table, in the center of the SAM, presents some interesting entries. Formal workers receive wages (column A), transfers from business (dividends, and payment of interest) and government transfers. The total income of formal workers is estimated at 1,190.63 billion reals. In column C, the income of formal household is being spent on 884.48 billion reals of final consumption goods from both sectors.

Informal workers receive wages (column B), transfers from business (dividends, and payment of interest) and government transfers. The total income of informal workers is estimated at 358.99 billion reals. In column E, the income of informal households is being spent on 346.35 billion reals of final consumption goods from both sectors. From this amount, purchases from the informal sector capture 70.89 billion reals, or 20.46 percent of

formal household's final demand. For the remaining institutions, other entries can be read in similar fashion.

The results suggest that the informal sector has an important role in the Brazilian economy. Economic policies that intend to reduce poverty and create employment must consider the importance of this sector to the whole economy and its structural relationship with the formal sector.

2.4 Conclusions

The analyses of the SAM and its components reveal the importance of the informal sector and the relative degree of structural interdependence of the Brazilian economy. Table 18 illustrates important statistics for the two sectors for Brazil in 2006.

There is a substantial difference in labor productivity between the two sectors. Formal sector workers are on average 8.39 times more productive than workers in the informal sector. The creation of jobs in the formal sector and further increases in productivity are important requirements for sustainable economic growth.

However, to achieve a sustainable process of economic growth, improvements in the labor productivity of informal sector workers are required. The increases in productivity in the informal sector release labor that can migrate toward the formal sector. The transfer of workers from the informal sector, a low labor productivity sector, to the formal sector, a high labor productivity sector, leads to a rise in average labor productivity in the whole economy. This is a precondition for many developing economies that pursue sustainable economic growth.

Turning now to labor remuneration, Table 18 reveals that there is a significant

inequality between the two sectors. Labor remuneration in the formal sector on average is about four times higher than labor remuneration in the informal sector. If we consider that labor remuneration in the informal sector includes both capital and labor remunerations, this difference should be even greater.

There are also significant differences in terms of employment indicators. The informal sector employs 53.70 million people, while the formal sector absorbs only 39.54 million people. This illustrates the informal sector's role as a creator of jobs and its capability to absorb surplus labor.

Additionally, it is interesting to make an in-depth analysis of the structural linkages between the two sectors. Table 19 provides the Leontief inverse matrix. The formal sector has the largest impact on the economy through its overall multiplier of 1.74. It means that a unit of increase in the demand of the formal sector good causes the total output to increase 1.74 units. The informal sector has a slightly lower impact on the economy; its overall multiplier is 1.72. These results suggest that policies that intend to improve economic activity should focus on stimulating demand in both sectors. However, the overall impact of the informal sector on the economy might be overestimated because of the aggregation of heterogeneous subsectors into the informal sector. Rada (2010) points out that further efforts should be made to estimate structural linkages between the formal sector and specific informal subsectors.

Analyzing the other elements of the Leontief inverse matrix, we can see that the elements of its main diagonal, as expected, are larger than one. The off-diagonal elements, measures of backward linkages between the two sectors, suggest that the informal sector is highly dependent on formal sector provisions of intermediate goods. To satisfy a unit of

increase in the demand of the informal commodity, the informal sector needs to demand 0.61 units from the formal sector's good. On the other hand, the formal sector is not very dependent from the informal sector's goods. The formal sector only needs 0.10 units from the informal sector's goods in response to an increase of a unit in its own demand.

To improve economic conditions and stimulate sustainable economic expansion, policies that focus on formal and informal sectors are required. The SAM and its multipliers suggest that the informal sector is important in the Brazilian economy as a generator of jobs and a strategic sector to absorb labor during economic downturns. Policies that try to increase labor productivity in the informal sector are relevant to boost economic growth. Any policy-driven Structuralist Calibrated model, therefore, should consider the intrinsic relationship between the two sectors and the major role that the informal sector has in the process of economic growth.

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Table 5: A social accounting matrix for a two-sector economy.

SAM for Brazil	Costs		Use of Income					Accumulation	Totals
	Formal (A)	Informal (B)	Formal households (C)	Business (D)	Informal households (E)	Government (F)	Exports (G)	(H)	(I)
(1) Formal	Intermediate inputs (I-O Matrix/TRU)		Formal HH consumption of formal goods (TRU)		Informal HH consumption of formal goods (TRU)	Public consumption (TRU)	Foreign demand (TRU)	Capital Accumulation of formal goods (TRU)	Formal sector output
(2) Informal			Formal HH consumption of informal goods (TRU)		Informal HH consumption of informal goods (TRU)				Informal sector output
(3)Formal Labor	Wages (TRU)			Dividends and interest paid to formal labor (CEI)		Government transfers fo formal HH (CEI)			Formal HH income
(4) Formal Business	Profits (TRU)								Business income

Table 5 Cont.

SAM for Brazil	Costs		Use of Income					Accumulation (H)	Totals (I)
	Formal (A)	Informal (B)	Formal households (C)	Business (D)	Informal households (E)	Government (F)	Exports (G)		
(5) Informal Labor		Wages and profits (TRU)		Dividends and interest paid to informal labor (CEI)		Government transfers fo informal HH (CEI)			Informal HH income
(6) Government	Taxes on production (TRU)		Direct and indirect tax paid by formal HH (TRU/CEI)	Corporate tax (CEI)		Transfer of income among public institutions (CEI)	Indirect tax (TRU)	Indirect tax (TRU)	Govern. income
(7) Imports	Imported inputs (TRU)		Imports (final goods) (TRU)	Buseiness net transfers of income to		Governemnt net transfers of income to the rest of			Payments to the rest of the world
(8) Savings			Formal HH saving (CEI)	Business saving (CEI)	Informal HH saving (CEI)	Government saving (CEI)	Foreign saving (CEI)	Total capital accumulation	
(9) Totals	Formal sector output	Informal sector output	Use of formal HH icome	Use of Business income	Use of informal HH icome	Government expenditure	Receipts from ROW		

Table 6: Trade margins for Brazil in 2006.

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
1	2997,09	0,00	1035,19	18371,56	0,00	0,00	0,00	0,00	0,00	0,00	0,00	419,41	70,76
2	134,03	359,27	3,42	2247,39	0,00	225,16	0,00	0,00	0,00	0,00	0,00	3,33	3,42
3	1583,81	528,97	19342,76	6817,85	1596,65	689,30	1693,73	6266,12	54,80	134,31	98,22	835,32	1235,17
4	14518,69	1662,51	4797,83	160375,09	2350,31	19417,26	4469,10	5270,31	3617,23	2542,07	450,98	29374,65	7427,98
5	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
7	0,00	0,00	0,00	-126950,09	0,00	-1594,85	-194125,19	0,00	0,00	0,00	0,00	-350,87	0,00
8	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
9	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
11	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
12	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
13	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Table 7: Transport margins for Brazil in 2006.

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
1	328.33	0.00	113.40	2012.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.95	7.75
2	166.72	446.91	4.25	2795.64	0.00	280.08	0.00	0.00	0.00	0.00	0.00	4.14	4.25
3	129.33	43.20	1579.52	556.74	130.38	56.29	138.31	511.69	4.47	10.97	8.02	68.21	100.86
4	1542.83	176.67	509.84	17042.29	249.76	2063.38	474.91	560.05	384.39	270.13	47.92	3121.50	789.34
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	-984.61	-1344.67	-3687.06	-12427.80	-764.04	-378.83	-5621.58	-5483.85	-1137.20	-752.00	-94.88	-2932.58	-1171.90
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 8: Coefficient matrix.

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.0859	0.0000	0.0297	0.5268	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0120	0.0020
2	0.0266	0.0713	0.0007	0.4461	0.0000	0.0447	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007	0.0007
3	0.0277	0.0093	0.3388	0.1194	0.0280	0.0121	0.0297	0.1097	0.0010	0.0024	0.0017	0.0146	0.0216
4	0.0264	0.0030	0.0087	0.2921	0.0043	0.0354	0.0081	0.0096	0.0066	0.0046	0.0008	0.0535	0.0135
5	0.0087	0.0081	0.0245	0.2268	0.1899	0.0029	0.0432	0.0172	0.0127	0.0105	0.0015	0.0836	0.0602
6	0.0000	0.0000	0.0090	0.0086	0.0000	0.0196	0.0010	0.0002	0.0035	0.0062	0.0239	0.0163	0.0638
7	0.0000	0.0000	0.0000	0.3255	0.0000	0.0041	0.4977	0.0000	0.0000	0.0000	0.0000	0.0009	0.0000
8	0.0155	0.0211	0.0579	0.1953	0.0120	0.0060	0.0883	0.0862	0.0179	0.0118	0.0015	0.0461	0.0184
9	0.0036	0.0071	0.0189	0.0835	0.0100	0.0026	0.0280	0.0126	0.1543	0.0817	0.0027	0.1910	0.1244
10	0.0076	0.0071	0.0075	0.1394	0.0098	0.0078	0.0333	0.0201	0.0179	0.1249	0.0038	0.0241	0.1374
11	0.0010	0.0016	0.0257	0.0314	0.0021	0.0025	0.0452	0.0084	0.0212	0.0068	0.0036	0.0374	0.0385
12	0.0001	0.0030	0.0188	0.0550	0.0127	0.0068	0.0362	0.0233	0.0293	0.0325	0.0050	0.0610	0.0686
13	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 9: Net taxes.

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
1	799.23	0.00	276.05	4899.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	111.84	18.87
2	53.15	142.48	1.35	891.26	0.00	89.29	0.00	0.00	0.00	0.00	0.00	1.32	1.35
3	833.82	278.48	10183.29	3589.36	840.58	362.89	891.69	3298.89	28.85	70.71	51.71	439.77	650.28
4	4126.95	472.57	1363.79	45586.74	668.08	5519.37	1270.35	1498.09	1028.20	722.59	128.19	8349.76	2111.41
5	281.21	264.23	794.85	7356.85	6157.26	92.83	1399.53	556.45	412.33	342.07	49.13	2710.91	1951.46
6	0.00	0.03	50.80	48.29	0.27	110.49	5.40	1.15	19.82	34.93	134.84	91.58	359.53
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	184.73	252.28	691.75	2331.66	143.35	71.08	1054.70	1028.86	213.36	141.09	17.80	550.20	219.87
9	121.29	235.23	628.27	2776.99	331.53	87.56	931.14	420.48	5136.29	2720.19	88.43	6357.18	4139.44
10	98.06	92.29	96.51	1802.86	126.29	100.47	430.90	259.91	231.52	1615.29	48.87	311.46	1776.07
11	1.52	2.45	39.60	48.42	3.20	3.92	69.67	12.95	32.65	10.53	5.48	57.75	59.33
12	3.71	89.42	566.10	1654.25	380.77	205.20	1089.57	700.94	880.59	977.87	148.92	1832.37	2060.67
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 10: Imports for Brazil in 2006.

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
1	505.58	0.00	174.63	3099.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70.75	11.94
2	418.11	1120.76	10.65	7010.91	0.00	702.39	0.00	0.00	0.00	0.00	0.00	10.39	10.65
3	1104.19	368.78	13485.25	4753.22	1113.14	480.56	1180.82	4368.57	38.20	93.64	68.47	582.36	861.13
4	4981.58	570.43	1646.21	55027.13	806.43	6662.36	1533.42	1808.32	1241.13	872.22	154.74	10078.89	2548.65
5	22.84	21.46	64.55	597.49	500.07	7.54	113.66	45.19	33.49	27.78	3.99	220.17	158.49
6	0.00	0.00	1.99	1.90	0.01	4.34	0.21	0.04	0.78	1.37	5.29	3.59	14.11
7	0.00	0.00	0.00	825.32	0.00	10.37	1262.03	0.00	0.00	0.00	0.00	2.28	0.00
8	95.53	130.46	357.72	1205.74	74.13	36.75	545.40	532.04	110.33	72.96	9.21	284.52	113.70
9	20.53	39.81	106.34	470.02	56.11	14.82	157.60	71.17	869.34	460.40	14.97	1075.98	700.62
10	23.08	21.73	22.72	424.41	29.73	23.65	101.44	61.19	54.50	380.25	11.50	73.32	418.10
11	13.11	21.16	341.92	418.10	27.63	33.81	601.54	111.80	281.94	90.93	47.33	498.66	512.30
12	2.83	68.14	431.42	1260.68	290.18	156.38	830.34	534.18	671.09	745.23	113.49	1396.43	1570.41
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 11: Taxes on imports for Brazil for year 2006.

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
1	9.34	0.00	3.23	57.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.31	0.22
2	0.51	1.37	0.01	8.55	0.00	0.86	0.00	0.00	0.00	0.00	0.00	0.01	0.01
3	0.34	0.11	4.10	1.44	0.34	0.15	0.36	1.33	0.01	0.03	0.02	0.18	0.26
4	291.58	33.39	96.36	3220.82	47.20	389.96	89.75	105.84	72.64	51.05	9.06	589.93	149.18
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 12: Make matrix.

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
1	183468	128	8	14963	0	0	8	0	0	0	18	0	0
2	0	38491	20	168	0	25	81	0	0	0	93	0	0
3	0	0	235027	825	0	6	0	0	0	0	475	0	0
4	0	3335	4572	1230853	32	296	380	0	0	0	913	0	0
5	0	0	0	0	141730	0	0	0	0	0	389	60	0
6	0	0	0	0	0	180558	0	0	0	0	606	0	0
7	0	0	994	360	0	2	319130	1037	369	0	1455	9407	0
8	0	0	0	0	0	3	84	195342	0	0	281	6	0
9	0	0	0	3	0	0	-680	0	150951	0	207	2	0
10	0	0	0	0	0	0	0	0	0	225857	441	0	0
11	0	0	0	2	0	0	61	0	0	0	188151	30	0
12	0	0	2	33	0	0	12889	0	0	0	20164	479840	0
13	170	0	16	1676	2744	0	1196	2236	208	0	654	9426	455837

Table 13: Market-share matrix.

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.99907	0.00305	0.00003	0.01198	0.00000	0.00000	0.00002	0.00000	0.00000	0.00000	0.00008	0.00000	0.00000
2	0.00000	0.91746	0.00008	0.00013	0.00000	0.00014	0.00024	0.00000	0.00000	0.00000	0.00043	0.00000	0.00000
3	0.00000	0.00000	0.97668	0.00066	0.00000	0.00003	0.00000	0.00000	0.00000	0.00000	0.00222	0.00000	0.00000
4	0.00000	0.07949	0.01900	0.98556	0.00022	0.00164	0.00114	0.00000	0.00000	0.00000	0.00427	0.00000	0.00000
5	0.00000	0.00000	0.00000	0.00000	0.98079	0.00000	0.00000	0.00000	0.00000	0.00000	0.00182	0.00012	0.00000
6	0.00000	0.00000	0.00000	0.00000	0.00000	0.99816	0.00000	0.00000	0.00000	0.00000	0.00283	0.00000	0.00000
7	0.00000	0.00000	0.00413	0.00029	0.00000	0.00001	0.95792	0.00522	0.00244	0.00000	0.00680	0.01886	0.00000
8	0.00000	0.00000	0.00000	0.00000	0.00000	0.00002	0.00025	0.98352	0.00000	0.00000	0.00131	0.00001	0.00000
9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00204	0.00000	0.99619	0.00000	0.00097	0.00000	0.00000
10	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	1.00000	0.00206	0.00000	0.00000
11	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00018	0.00000	0.00000	0.00000	0.87984	0.00006	0.00000
12	0.00000	0.00000	0.00001	0.00003	0.00000	0.00000	0.03869	0.00000	0.00000	0.00000	0.09429	0.96204	0.00000
13	0.00093	0.00000	0.00007	0.00134	0.01899	0.00000	0.00359	0.01126	0.00137	0.00000	0.00306	0.01890	1.00000

Table 14: Use matrix sector by sector for Brazil in 2006 at basic prices.

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13
1	14865.16	39.63	5132.17	92554.31	46.46	386.26	93.68	104.58	71.51	50.12	8.94	2618.30	491.12
2	771.24	2057.83	29.41	12940.83	1.22	1294.86	54.12	3.95	2.87	1.39	1.06	29.80	26.76
3	5962.74	1988.60	72641.39	25786.97	5998.29	2610.39	6385.53	23536.34	219.74	510.33	371.08	3185.98	4664.25
4	23666.73	2907.63	9201.62	261199.91	3926.13	31578.75	7622.08	8990.44	5875.47	4129.91	746.98	47617.00	12162.26
5	1229.28	1155.49	3484.66	32165.44	26909.21	407.08	6135.74	2436.39	1811.87	1499.47	216.36	11865.08	8547.07
6	0.60	1.93	1643.76	1566.97	9.96	3543.19	200.41	41.82	648.05	1123.77	4324.08	2958.09	11547.45
7	54.15	66.88	598.63	125636.74	166.17	1661.61	191126.43	439.08	386.29	362.68	56.22	1122.92	790.18
8	3428.19	4681.96	12843.86	43309.42	2660.65	1320.13	19634.61	19094.56	3965.31	2620.22	331.44	10220.81	4091.37
9	550.34	1067.22	2854.86	12336.53	1504.08	394.39	3826.47	1908.87	23299.78	12338.74	401.82	28839.87	18782.30
10	1713.29	1612.69	1697.08	31504.56	2206.89	1756.00	7546.55	4543.60	4053.30	28217.46	855.19	5456.72	31039.77
11	185.13	298.70	4826.04	5926.51	390.30	477.67	8526.91	1578.49	3979.88	1284.26	668.11	7039.44	7232.03
12	79.64	1456.34	9534.71	32021.63	6106.72	3383.69	25961.48	11333.94	14452.54	15713.05	2443.61	29955.15	33597.19
13	111.48	110.23	432.19	2577.99	679.55	138.17	1443.18	506.25	409.64	391.97	58.43	1051.84	924.56

Table 15: Demand matrix (sector by sector) at approximately basic prices.

Sectors	Exports	Government	Consumption	Investment
1	23661.24	41.71	45267.28	13160.53
2	20091.95	0.47	407.75	1162.48
3	28537.89	2.30	52555.84	1375.35
4	204203.87	3431.29	439574.66	173546.27
5	7.67	1.41	44296.86	9.94
6	920.10	0.00	447.18	152186.62
7	2711.61	222.11	7230.46	121.83
8	4919.27	0.14	62584.46	9.60
9	700.84	0.06	41671.22	5.63
10	1855.73	1553.15	100674.94	11.07
11	2245.53	0.71	138859.64	4724.65
12	24541.68	11278.42	289143.44	1924.76
13	844.67	456063.22	8129.33	290.29

Table 16: Sectoral value-added shares.

	Informal	Formal
Agriculture	0.505	0.495
Mining and Quarrying	0.027	0.973
Energy	0.000	1.000
Manufacturing	0.062	0.938
Construction	0.265	0.735
Wholesale and Retail	0.210	0.790
Transport	0.227	0.773
Information Services	0.127	0.873
Financing and Insurance	0.009	0.991
Real Estate	0.016	0.984
Other Services	0.227	0.773
Distribution of electricity	0.000	1.000
Public Administration	0.000	1.000

Table 17: Social accounting matrix for Brazil for year 2006.

SAM 2006 (billion of reals)	Costs		Use of Income						
	Formal (A)	Informal (B)	Formal HH (C)	Business (D)	Informal HH (E)	Government (F)	Exports (G)	Investment (H)	Totals (I)
(1) Formal (F)	1334.10	169.53	722.43		275.46	472.59	315.24	348.53	3637.89
(2) Informal (I)	216.31	30.97	162.05		70.89				480.23
(3) Labor (F)	902.58			221.54		66.12	0.39		1190.63
(4) Business (F)	825.00								825.00
(5) Labor (I)		279.73		61.02		18.24			358.99
(6) Government	206.03		110.61	138.74		176.63	25.21	25.03	682.25
(7) Imports	153.87		93.35	35.60		15.00		23.47	321.29
(8) Savings			102.18	368.10	12.63	-66.33	-19.56	-397.03	0.00
(9) Totals	3637.89	480.23	1190.63	825.00	358.99	682.25	321.29		

Table 18: Summary indicators for Brazil for year 2006.

Economic indicators	
Relative labor productivity (formal/informal)	8.39
Relative wage (formal/informal)	4.38
Informal employment (% of total)	57.59
Saving rate formal HH (%)	8.58
Saving rate informal HH (%)	3.51
Current account balance/GDP (%)	-0.97

Table 19: The Leontief inverse matrix.

Sectors	1	2
(1) Formal	1.637	0.618
(2) Informal	0.104	1.108
Multiplier	1.741	1.726

2.6 Appendix: The Flow of Funds Table

Because the Brazilian Statistical Office does not directly release the complete Flow of Funds Table, we attempt to estimate the transfers of resources among institutions indirectly. The Integrated Economic Accounts in 2006 provides the main information needed to a reliable estimation of the transfers of income among institutions. This table presents five major institutions: families, government, financial enterprises, nonfinancial enterprises, and the rest of the world. The flow of funds table is the source of data to build the quadrant in the center of the SAM. Some of the entries in the center of the SAM are: transfer of income from government to workers, income from properties, rents, dividends and interest paid to workers, capital transfers, final goods imports, government and business transfers to the rest of the world, capital goods imports, etc.

To find the values of the cells in the secondary distribution of income of the SAM, this study looked at the transactions among the five institutions. First, transfers from government to households and transfers from capitalist to households are endogenous. Treating transfers as a residual was necessary because of the inconsistencies between the sources of data. The shares of value-added for formal and informal activities were applied as weights to separate transfers between formal and informal workers. Second, informal households do not pay income tax. Third, government savings, capitalist savings, and household savings come from the same table, code/transaction B.12. Moreover, the current account result is derived from the transaction B.12 (resources) in the account rest of the world.

The next scalar is the vector of direct tax paid by families. Its value is obtained from transaction D.5, income tax, in the account uses of family (S.14) plus 177 million reals

(direct tax paid by non-profit firms). Its value is 81,950 million plus 177 that is equal to 82,127 million reals. Households pay direct and indirect taxes, therefore, the additional values of indirect tax is added. The indirect tax values come from our estimations of the input-output matrix.

Another important scalar is the net remuneration of employees received from the rest of the world. It is the result of transaction D.1 (uses, rest of world), 864, minus transaction D.1 (resources, rest of world), 475.

The scalar of direct tax paid by firms, including financial and non-financial firms, is obtained from transaction D.5, income tax, in the left side of the CEI (Uses). The value of 138,740 million reals was obtained adding the rubric S.11 (firms), 14,639 million reals, and account S.12 (nonfinancial firms) with the value of 124101 million reals.

The scalar of imports follows the same procedure to calculate the indirect tax. It comes from the estimations of the Input-Output Matrix. Imports are separated among three purposes: imports of final goods, imports of inputs and imports of capital goods.

However, the task to estimate the scalars rmc, 35.60 billion reals, and rmg, 14.01 billion reals, is more cumbersome. The scalars rmc and rmg stand for the net transfer of property income from business to the rest of the world and net transfer of income from government to rest of the world, respectively.

Table 20 shows the gross transfers between institutions. The task is to calculate net results to get rmc and rmg. The transactions D.4 represents the total income from property (D.4=D.41+D.42+D.43+D.44+D.45). D.41 represents the interest rate paid. D.45 represents the remuneration of land while D.7 represents other transfers.

The next step is to calculate the net transfers. For instance, government in the

transaction D.41 is the only net transfer institution. It sends 144.610 billion (Table 22), 248.630 minus 104.03 (in Table 20), to firms, families and rest of the world. The same procedure is used to calculate net transfers for each institution.

Finally, the government and firms are the two institutions that make net transfer to families and the rest of world. In Table 23, the scalars rmc and rmg are presented. The net transfer from government to the rest of world is the result of adding the values in the government column. The same process is applied to calculate the net transfer of property income from business to the rest of the world. The scalars rmc and rmg assume, respectively, the values of 35.60 and 14.01. To find out the total amount that government send to rest of world, the amount of government imports must be added.

Table 20: Economic transfers among institutions (billions of reals).

USES						RESOURCES				
Total	RW	Families	Government	Business	CODE	Business	Government	Families	RW	Total
1507.29	14.47	66.87	248.63	1177.32	D.4	1069.87	135.04	228.94	73.45	1507.29
	12.38	66.73	248.63	931.93	D.41	996.81	104.03	123.08	35.76	
	2.09			183.10	D.42	70.97	10.64	65.88	37.69	
				42.19	D.44	2.09	0.13	39.97		
		0.14		20.11	D.45		20.25			
286.11	10.54	28.42	206.01	41.13	D.7	28.99	208.60	47.34	1.18	286.11
		5.62	0.09	3.35	D.71	9.06				
				9.06	D.72	3.30	0.03	5.73		
	10.35	22.81	18.01	26.04	D.75	4.76	29.93	41.60	0.91	
40.72			15.90	24.82	D.8			40.72		40.72
1834.12	25.01	95.30	470.54	1243.27	TOTAL	1098.86	343.65	316.99	74.62	1834.12
271.30			126.89	144.41	NET RESULT			221.69	49.61	271.30

Table 21: Economic transfers among institutions (billions of reals).

USES						RESOURCES				
Total	Rest of the World	Families	Government	Business	CODE/TRANSACTION	Business	Government	Families	Rest of the World	Total
	12.38	66.73	248.63	931.93	D.41	996.81	104.03	123.08	35.76	
	2.09			183.10	D.42	70.97	10.64	65.88	37.69	
				42.19	D.44	2.09	0.13	39.97		
		0.14		20.11	D.45		20.25			
		5.62	0.09	3.35	D.71	9.06				
				9.06	D.72	3.30	0.03	5.73		
	10.35	22.81	18.01	26.04	D.75	4.76	29.93	41.60	0.91	

Table 22: Economic transfers among institutions (billions of reals).

USES						RESOURCES				
Total	Rest of the World	Families	Government	Business	CODE/TRANSACTION	Business	Government	Families	Rest of the World	Total
			144.61		D.41	64.89		56.35	23.37	
				112.13	D.42		10.64		35.60	
				40.10	D.44		0.13	39.97		
		0.14		20.11	D.45		20.25			
		5.62	0.09		D.71	5.71				
				5.76	D.72		0.03	5.73		
			0.08		D.74				0.08	
	9.44			21.27	D.75		11.92	18.80		

Table 23: Economic transfers among institutions (billions of reals).

Uses				Resources	
Total	Government	Business	Code / Transaction	RW	Total
23.37	23.37		D.41	23.37	23.37
35.60		35.60	D.42	35.60	35.60
			D.71		
			D.72		
0.08	0.08		D.74	0.08	0.08
-9.44	-9.44		D.75	-9.44	-9.44
49.61	14.01	35.60	Net income transfer to rest of the world	49.61	49.61

CHAPTER 3

DISTRIBUTION, STRUCTURAL CHANGE AND ECONOMIC EXPANSION OF A DUAL ECONOMY

3.1 Introduction

One of the crucial questions in economics is whether the redistribution of income toward labor generates economic expansion. Neoclassical and heterodox economists address this question in different ways. The neoclassical model's closure is based on a saving-driven investment, also known as Say's Law. Assuming lower propensities to save by labor, a redistribution of income towards it is expected to cause a reduction in aggregate savings, consequently reducing investment and stopping the process of economic expansion.

Keynesians and structuralists work with a demand closure which allows for an independent investment demand function. In this setting a transfer of income to labor, has the potential to spur higher demand, investment and, therefore, economic activity.

The closure of the model and the specification of the investment function are crucial in determining if redistribution can generate economic expansion. If the response of investment to increases in demand is stronger than its response to profits, redistribution can stimulate economic growth. Indeed, the accelerator theory of investment postulates that investment responds to changes in output.

The purpose of this chapter is to present a dual model that attempts to describe the Brazilian economy after 1994. The dual model must be capable of shedding light on the interaction between the two sectors during economic expansion and provide insights in different scenarios based on whether the economy is profit-led or wage-led. In this way, the current chapter attempts to fill a gap in the literature on growth and distribution and its application to Brazil.

The Structuralist model presented in this chapter is standard (Taylor 1983). The model describes an open, developing economy with two sectors, two commodities, and three classes. The model assumes no financial sector. We use the dual model in the short run to compare the effects of four experiments: an income transfer toward workers in the modern sector, an income transfer toward workers from the subsistence sector, an investment shock, and an exchange rate shock. Additionally, sensitivity analysis experiments are applied to test the sensitivity of model results with respect to different economic scenarios.

This chapter is organized as follows. Following this introduction, the two-sector model is presented. Subsection 3 analyzes the two experiments: an income transfer toward workers in the modern sector and an income transfer to workers from the subsistence sector, to find out how the system accommodates the external shocks. Subsection 4 presents simulation results for the Brazilian economy. Finally, the results are summarized in the conclusion. The complete description of the mathematical model appears in the appendix.

3.2 The Model

The application of Structuralist Calibrated models for Brazil started in the 1980s. Taylor and Lysy (1980) have a model for the Brazilian economy that investigates the economic results of an exogenous change in distribution of income. Subsequent research attempted to address questions related to balance of payments constraints and policies of stabilization.

The model presented in this section is straightforward. It represents a surplus labor, open economy with two sectors, two commodities, and three economic classes - a capitalist, a modern, and a subsistence household, respectively. The model can be considered structuralist because it takes into account the structural features of the economy as important determinants of its evolution. The antecedents of the model are the Taylor (1983) and Rada (2007) two-sector models.

The Social Accounting Matrix (SAM) in Table 24 provides a schematic description of the economy. It describes the circular flow of income for the economy. The Social Accounting Matrix consists of a union of input-output (I-O) table, which describes the inter-industry transactions in the economy, and a flow of funds table, which shows the income transfers between institutions. In addition, the SAM is a square matrix, which is a necessary condition to the existence of one solution. The columns of the matrix represent purchases and the rows represent sales. The sum of each row must be equal to the sum of each column to guarantee the national accounting condition that income is equal to expenditure.

The two sectors that are important in the analysis are the subsistence sector (n)

and the modern sector (t).[1] The former produces a nontradable (N) good while the latter produces a tradable (T) good. They are not perfect substitutes. Private income is distributed among three classes: capitalists in the modern sector, workers in the modern sector, and workers in the subsistence sector. Capitalists do not consume. Workers spend all of their income on the consumption of both tradable and nontradable goods, which is in agreement with the classical approach. The modern sector produces its own tradable commodity that can be exported, consumed or invested. In this way, the foreign sector supplies intermediate inputs to the modern sector. It is important to emphasize that the subsistence sector[2] presents a low labor productivity level, whereas the modern sector does not.

A central assumption of the model is that there is no unemployment in the economy. Workers are assumed to always find a job in the subsistence sector. As in the extensions of the Lewis model, there is difference in wages; that is, wages in the modern sector tend to be higher than in the subsistence sector. The equation below formalizes the labor market assumption.

$$L = L_t + L_n \tag{3.1}$$

The labor remuneration in the subsistence sector is $w_n = \varepsilon_n Z_n$; hence, there is no clear distinction between capital and labor income in this sector. The transfer of workers from the subsistence sector, a low labor productivity sector, to the modern sector, a high

[1]Throughout this study the label `L,' the subscripts `l' and `n' are used interchangeably to refer to the subsistence (informal) or low productivity sector; the terms `modern,' the subscript `h,' the subscript `t,' and the label `H' represent formal activities.

[2]There is no division between labor and capital income in the subsistence sector.

labor productivity sector, leads to a rise in average labor productivity in the whole economy. With a higher capital-labor ratio and access to capital, the industry can make any transferred worker more productive.[3]

The subsistence sector is supply-constrained; that is, the price level of the subsistence sector adjusts to achieve the new equilibrium in the short run. There is no excess capacity in this sector. The output equation of the subsistence sector is presented below. Considering that labor productivity is equal to the subsistence sector value added divided by the subsistence sector labor, or $\varepsilon_n = Y_n/L_n$, we can rewrite the equation as:

$$Y_n = \varepsilon_n L_n \tag{3.2}$$

In contrast to the subsistence sector, the modern sector operates with excess capacity. It is a quantity-clearing sector and, hence, demand-constrained. Output in the modern sector is supposed to change to accommodate disturbances in other variables. Notice that capital stock is present only in the modern sector. The variable investment is endogenous. It is a function that incorporates the value-added of the modern sector and profit as explicative variables. The investment function below includes the accelerator and the effect of profits on investment.

$$I_t = z_0 + z_1\Pi + z_2 Y_t \tag{3.3}$$

[3]Empirical evidence shows that the Kaldor-Verdoorn (KV) Law is important in explaining the process of economic growth and the standing of industry as the engine of growth. For instance, Marinho et al. (1998) estimated the KV Law for the manufacturing sector of the Brazilian economy during 1985-1997, and they found a statistically significant verdoorn coefficient. Their Error Correction Model (ECM) shows that an increase in manufacturing output causes a rise in its labor productivity of .88 percent in the short run and .33 percent in the long run.

Before we start to analyze the short-term adjustment of the model, some additional variables must be introduced. Let us begin with some important variables. First, the value-added of the two sectors is proportional to their respective supply. The shares of value-added in supply are presented below:

$$\nu_t = \frac{Y_t}{X_t} = 1 - a_{t_t} - a_{n_t} - fe \tag{3.4}$$

$$\nu_n = \frac{Y_n}{X_n} = 1 - a_{n_n} - a_{t_n} \tag{3.5}$$

where f, $f = \frac{M}{X_t}$, and e, stand, respectively, for the share of imports in supply and nominal exchange rate. The element a_{ij} (i,j=n,t) represents a technical coefficient; the term input-output coefficient is also used. For instance, the element a_{t_t} measures a fixed relationships between the formal sector's output and its own produced inputs. In this sense, $a_{t_t} X_t$ represents intermediate sales of the formal sector to itself.

Moreover, the model has exports and imports as endogenous variables that respond to price and output changes. The two equations are presented below:

$$Et = \chi^0 (\rho)^{\chi} X_f \tag{3.6}$$

$$M = \phi^0 (\rho)^{-\phi} X_t \tag{3.7}$$

where ρ, $\rho = \frac{eP^*}{P_t}$, is the real exchange rate and X_f is the foreign demand for the modern sector goods. The parameters ϕ and χ stand, respectively, for exports and imports' trade elasticities.

Turning now to sectoral prices, some considerations are important. The modern sector price, P_t, is established by an accounting relationship. Different from the subsistence sector, this price is cost-determined. It might be mathematically expressed as a weighted average of cost components (see Arnim and Rada 2011 for more details). Using the variables introduced previously, the function is presented below:

$$P_t = \frac{a_{nt}P_n + \nu_t Z_t + fe}{1 - a_{tt}} \tag{3.8}$$

To include intermediates into the model, we need to incorporate value added prices of the two sectors. In this sense, Z_n stands for the value-added price of the subsistence sector and the variable Z_t represents the value added price for the traditional or modern sector. The former is an accounting equation to clear the cost decomposition while the latter is a behavior function. However, since we consider the modern sector labor-output ratio, b_t, fix, the net price Z_t responds to changes in the formal sector wage and profit share. The respective equations are presented below:

$$Z_n = \frac{(1 - a_{nn})P_n - a_{tn}P_t}{\nu_n} \tag{3.9}$$

$$Z_t = \frac{1}{(1-\pi)} w_t b_t \tag{3.10}$$

In conclusion, P_t responds to costs, Z_n reacts to changes in the excess of P_n over sectoral costs, and Z_t reacts on changes in the functional distribution of income.

Finally, the aggregate price for the whole economy, the GDP-deflator, is calculated as a Fisher index[4] of the two sectoral prices. It is estimated as the square root of the multiplication of Laspeyres and Paashe indexes, considering sectoral value added prices and quantities pre- and post shocks.

To analyze the short-term adjustment of the model, we need to consider the excess demand function for both markets. The macro equilibrium condition is achieved when the excess demand equations for both subsistence and modern sectors are zero, $ED_n = ED_t = 0$, which describes a situation when the Social Accounting Matrix balances. The excess demand equation for the subsistence sector, ED_n, is the difference between aggregate demand and aggregate supply (X_n). The excess demand equation for the subsistence sector is presented below:

$$ED_n = a_{nn} X_n + a_{nt} X_t + C_{wn}^{\ n} L_n + C_{wt}^{\ n} L_t - X_n = 0 \tag{3.11}$$

where $C_{wn}^{\ n}$ and $C_{wt}^{\ n}$ stand, respectively, for the consumption of the subsistence good by workers in the subsistence and modern sectors.

We assume that both workers consume the nontradable good. We use the linear

[4]The procedure to estimate the GDP-deflator is based on Arnim and Rada (2011).

expenditure system (LES) to incorporate the consumer choice into the analysis, which is derived mathematically in the Appendix. Notice that both workers consume a minimum amount, θ, defined as the floor-level consumption of the subsistence good. A Positive θ [5] implies income-inelastic subsistence good demand and income-elastic modern sector's good demand. The rest of the income is divided between the two goods, in this case, $(1-\alpha)$ and $(1-\beta)$. We can include the demand equations from the Appendix to rewrite the equation as:

$$ED_n = a_{nn}X_n + a_{nt}X_t + \left(\frac{(1-\beta)(w_n + TR_n)}{P_n} + \beta\theta_n\right)(L - b_t X_t) + \left(\frac{(1-\alpha)(Z_t w_t + TR_t)}{P_n} + \alpha\theta_t\right)(b_t X_t) = 0 \tag{3.12}$$

where TR_n, b_t, TR_t, α, and β, stand for the income transfer from profit to labor in the subsistence sector, the labor-output ratio of the modern sector, the transfer to workers in the modern sector, the share of worker's income in the modern sector spent on consumption of the modern good and the share of income spent by the subsistence sector on the consumption of the modern good, respectively. If we use the variables previously introduced and make some extra manipulation to solve the equation for P_n, we can get:

$$P_n = \frac{(1-\alpha)(Z_t \nu_t X_t (1-\pi) + TR_t) - \dfrac{(1-\beta)((\nu_t Z_t + fe))a_{tn}X_n}{(1-a_{tt})} + (1-\beta)TR_n}{\beta(X_n - a_{nn}X_n - \theta_n L + \theta_n b_t \nu_t X_t) - \alpha\theta_t b_t \nu_t X_t - a_{nt}X_t + \dfrac{(1-\beta)a_{nt}a_{tn}X_n}{1-a_{tt}}} \tag{3.13}$$

[5] See Taylor (1979, p. 219-22) for more details.

Following similar procedure for the modern sector, we can get the results below. Notice that this is a demand-constrained sector; hence, we should solve the equation for gross output (X_t).

$$ED_t = a_{tt}X_t + a_{tn}X_n + C_{wt}^{\ t}L_t + C_{wn}^{\ t}L_n + E_t + I_t - X_t = 0 \qquad (3.14)$$

where E_t and I_t stand, respectively, for tradable good exports and investment. Using the Linear Expenditure System (LES) demand functions described in the Appendix, we can rewrite the above equation as follows:

$$ED_t = a_{tt}X_t + a_{tn}X_n + \frac{\alpha(Z_t w_t + TR_t - P_n\theta_t)}{Pt}(b_t X_t) + \frac{\beta(w_n + TR_n - P_n\theta_n)}{P_t}(L - b_t X_t) + E_t + I_t - X_t = 0 \qquad (3.15)$$

Then, setting the equilibrium condition that $ED_t = ED_n = 0$ and solving for the endogenous variable X_t, we can get:

$$X_t = \frac{\frac{(a_{nt}P_n + \nu_t Z_t + fe)}{1 - a_{tt}}(a_{tn}X_n + z_0 + \chi^0(\rho)^{\chi}X_f - \beta a_{tn}X_n) + \alpha TR_t + \beta TR_n - \beta P_n\theta_n L + \beta P_n X_n - \beta a_{nn}P_n X_n}{\frac{(a_{nt}P_n + \nu_t Z_t + fe)}{1 - a_{tt}}(1 - z_1\pi\nu_t - z_2\nu_t - a_{tt}) + \alpha P_n\theta_t b_t\nu_t - \alpha(1-\pi)Z_t\nu_t - \beta P_n\theta_n b_t\nu_t} \qquad (3.16)$$

The above equations (see the glossary in the Appendix) might be arranged in blocks as follows:

1. Sectoral Balances

$$a_{nn}X_n + a_{nt}X_t + C_{wn}^{\ n}L_n + C_{wt}^{\ n}L_t - X_n = 0 \tag{3.17}$$

$$a_{tt}X_t + a_{tn}X_n + C_{wt}^{\ t}L_t + C_{wn}^{\ t}L_n + E_t + I_t - X_t = 0 \tag{3.18}$$

2. Price Equations

$$Z_n = \frac{(1-a_{nn})P_n - a_{tn}P_t}{\nu_n} \tag{3.19}$$

$$Z_t = \frac{1}{(1-\pi)} w_t b_t \tag{3.20}$$

$$P_n \propto a_{nn}X_n + a_{nt}X_t + C_{wn}^{\ n}L_n + C_{wt}^{\ n}L_t - X_n \tag{3.21}$$

$$P_t = \frac{a_{nt}P_n + \nu_t Z_t + fe}{1-a_{tt}} \tag{3.22}$$

3. Total Disposable Income by Classes

$$DY_{wt} = (P_t C_{wt}^{\ t} + P_n C_{wt}^{\ n})L_t = Z_t w_t b_t Y_t + TR_t L_t \tag{3.23}$$

$$DY_{wn} = w_n b_n Y_n + TR_n L_n \tag{3.24}$$

$$DY_{\pi} = (1 - t_t - t_n)(\pi Z_t Y_t) \tag{3.25}$$

$$DY_f = eP^* fX_t \tag{3.26}$$

4.Consumer Demand Equations

$$D(c_{wt}^{\ n}) = \frac{(1-\alpha)(Z_t w_t + TR_t)}{P_n} + \alpha\theta_t \tag{3.27}$$

$$D(c_{wt}^{\ t}) = \frac{\alpha(Z_t w_t + TR_t - P_n\theta_t)}{Pt} \tag{3.28}$$

$$D(c_{wn}^{\ t}) = \frac{\beta(w_n + TR_n - P_n\theta_n)}{P_t} \tag{3.29}$$

$$D(c_{wn}^{\ n}) = \frac{(1-\beta)(w_n + TR_n)}{P_n} + \beta\theta_n \tag{3.30}$$

5. Investment Function

$$I_t = z_0 + z_1\Pi + z_2 Y_t \tag{3.31}$$

6. Saving-Investment Balance

$$S_{\pi} + S_{f} = P_{t} I_{t} \tag{3.32}$$

$$(1 - t_{n} - t_{t})\pi \frac{Z_{t}}{P_{t}} Y_{t} + e(P^{*}/P_{t}) f X_{t} - E_{t} - z_{0} - z_{1}\pi Y_{t} - z_{2} Y_{t} = 0 \tag{3.33}$$

The equation 3.33 exhibits the macroeconomic balance between saving and investment. If we include equations 3.27, 3.43 and 3.44 into equation 3.32 and divide by Pt, we get the saving-investment balance equation, 3.33. The total saving is the sum of saving out of profits and foreign saving. The closure of the model is Keynesian, that is, investment is triggered by changes in output. In other words, the investment level rises in response to a change in aggregate demand.

The system is locally stable if and only if the trace of the Jacobian matrix is negative and the determinant of the Jacobian matrix is positive. Also, the two eigenvalues of the Jacobian of partial derivatives should be positive to imply a system with local stability. See Appendix 3.7 for more details.

The macroadjustment process can be explained using the excess demand equations (eq. 3.12 and 3.14). From equation 3.12, a surge in the modern sector's gross output, X_{t}, generates an excess demand in the subsistence sector. This disequilibrium is solved through an increase in the price of the subsistence sector good. The variables P_{n} and X_{t}, therefore, are positively related, and the excess demand curve, ED_{n}, is positively sloped, as shown in Figure 3.

In the modern sector, equation 3.14 shows that an increase in P_n leads to an expansion in the gross production of the modern sector, X_t. Consequently, the modern sector excess demand curve, ED_t, is positively sloped.

The magnitude of the increase in X_t, however, is not clear. The magnitude of the increase in X_t will depend on Engel's law.[6] An increase in P_n can affect X_t through two channels. First, an increase in P_n leads to an increase in wages of the subsistence sector that will cause a rise in demand of the modern sector goods. Second, a rise in P_n will cause a decrease in real wages in the modern sector because workers consume the subsistence sector's good. As a result, there is a reduction in the demand for the modern sector's goods. The final result will depend on the magnitude of these two effects. A strong Engel's effect, therefore, will lead to a lower demand from the modern sector, which will cause X_t to grow less. In some cases, Engel's effect may be so strong that a rise in P_n leads to a decline in X_t. Conversely, a weak Engel's effect will cause X_t to grow faster.

3.3 Simulation Experiments and Comparative Statics' Results

In this section we analyze the comparative static results of two experiments: an increase in income transfers toward workers from the modern sector and a rise in income transfers to workers from the subsistence sector. The transfer is financed by an income tax on capitalists' income.

[6]Empirical evidence shows that food consumption is income-inelastic, that is, a 1 percent increase in income will produce less than a 1 percent rise in food consumption

3.3.1 Effects of Transfers Toward Workers

To simplify things, let us consider the comparative static's results of the model without intermediate inputs. In this context, a straight income transfer to workers[7] in the modern sector triggers excess demand in the two sectors because TRt appears in equations 3.12 and 3.14. The adjustment process in the subsistence sector is simpler. The imbalance is solved through increases in the price of the subsistence commodity, Pn. The adjustment variable, Pn, increases until the market clears. There is a shift to the left in the subsistence sector schedule: it represents a movement from point A to B in Figure 3.

The adjustment process in the modern sector is more complex. A higher disposable labor income in the modern sector, through an increase in income transfers, generates an expansion in the demand for the modern good. The imbalance is solved mainly through increases in quantity, X_t, since the price of modern good is assumed to be fairly stable. As a result of the consumption expansion, the supply of the modern good increases to accommodate the demand shock. Visually, this process is represented by a shift of the modern sector schedule to the right, i.e., a movement from point B to C in Figure 3.

The expansion of the gross output level of the modern sector, Xt, creates a new imbalance in the subsistence sector. The movement of workers from the subsistence sector to the modern sector creates higher productivity in the former because labor is considered redundant. Higher productivity, ε_n, compensates for the reduction in labor, keeping the supply constant and preventing further increases in prices, P_n. The final

[7]This simulation involves the situation where t_t rises from zero with the respective increase on TR_t in the very short run, ceteris paribus.

outcome of the simulation, point C in Figure 3, is higher production, employment and prices.

Additionally, the investment function, eq. 3.31, plays an important role in the short and medium term analysis. In Figure 4 we can see the adjustment process using the saving-investment balance equation, eq. 3.33. The modern sector is responsible for the creation of the domestic saving necessary to match a rise in investment. The investment function, equation 3.31, reveals the investment demand, while equations 3.43 and 3.44 stand for the saving supply.

There are three effects of income transfer toward workers in the modern sector in the context of excess capacity. Exports, Eh, have been held constant. First, the transfer of income from capitalists, with a high propensity to save, to workers, who are assumed not to save, leads to an increase in aggregate demand. Inasmuch as the economic level of activity responds positively to a surge in consumption, the final outcome will be higher output level.

The second effect is related to a change in investment demand. Empirically, the coefficient z_2 in eq. 3.31 is higher than z_1. According to Taylor (1983, p.17), this econometric result holds for many developing countries. The investment demand will rotate counterclockwise since expansion in the modern sector output level (Y_t) triggers higher investment demand. In this way, capitalists will react to an increase in the output level, Y_t, by adjusting their investment level, I.

Finally, an increase in saving supply follows a rise in real activity, Y_t, at a given profit level. The immediate decline in capitalist savings as a result of a positive income tax, t_t, is compensated by the subsequent growth in real activity, Y_t, and profits, Π. In

this sense, the saving supply accommodates the increase in investment through the rise in output, as shown in Figure 4. The effect of income transfers toward labor in the modern sector is, therefore, higher investment, output (Yt), and profits.

A positive transfer shock to subsistence sector workers will present similar results. It will trigger demand in the two sectors because income transfer, TRn, appears in both excess demand equations. In sum, a straight income transfer toward workers in this sector leads to several imbalances, which result in a higher level of output (Y_t), investment, and profits.

Therefore, the model suggests that the redistribution of income toward labor has a positive effect on economic activity. The rise in consumption and investment will be responsible for the boost in economic activity. The model supports the thesis that economic prosperity is related to some degree of income equality. In the long run, redistribution of income might lead to significant improvements in labor productivity through education and health. The next section takes a further step: It analyses the empirical results for the Brazilian economy.

3.4 Empirical Results

In this section, four simulation experiments are analyzed: an income transfer toward modern sector workers, an income transfer to subsistence sector labor, an exchange rate depreciation, and an investment shock. To estimate the post-shock results of the last simulation, we need to employ a slightly different model, though. Here, the investment level is considered an exogenous variable. For the remaining experiments, an independent (endogenous) investment function, a la Kalecki and its colleague Steindl, is

applied. The three components of the independent investment function are: animal spirits, a coefficient measuring the effect of profits on investment, and an accelerator. The animal spirits component of the investment function represents the part of investment that is not explained by changes in profits and output. In other words, it is simply the autonomous part of the investment.

Before we explore the results, it is important to highlight some assumptions of the model. First, it is assumed that only modern sector imports exist; there are no subsistence sector and final goods imports. Second, the parameters of the investment function come broadly from econometrics. The effect of profit changes on investment level is supposed to be small. It is assumed to be about 3 percent, since econometric estimations of investment functions usually do not include any measure of profits as an explanatory variable. In contrast, the accelerator is supposed to be about ten percentage points. Lastly, animal spirits are calculated as a residual. However, one difficulty appears in the process of estimation of these parameters. It occurs because the Brazilian economy has low level of investment relative to GDP compared to other fast-growing, emerging economies. The solution is to make the relative size (value) of the parameters with respect to each other stable and proportional. In other words, if, for instance, econometric estimations suggest that the accelerator is five times higher than the effect of profits on investment, we used this estimation to set our two parameters. In this sense, the parameters are, on average, in line with empirical evidence.

The fraction of income spent in the modern good, α, from modern sector workers and the fraction of income spent in the modern good, β, by workers in the subsistence sector depend on budget shares and Engel elasticities. Floor consumption of subsistence

goods depend on the same variables and marginal budget shares. We assume the ratio of floor consumption with respect to total consumption of the modern sector households, $\frac{\alpha\theta_t L_t}{(c_{wt}^{\ t} L_t + c_{wt}^{\ n} L_t)}$, to be 4 percent, while the ratio to the informal sector is twelve percent. It means that only a small part of worker's demand is invariable to changes in their real income.

In Table 26, two calibrations are considered: a scenario where trade price elasticities are set to zero, and an alternative scenario where price elasticities of exports and imports are relatively high (χ, ϕ=0.75). For every shock, Table 26 shows two columns. Column (1) reveals the results for the first calibration, while column (2) shows the results for the second. The top block of the table describes the results of macroeconomic indicators, such as inflation and real GDP growth. All the statistics are shown in percentage points. Lastly, the bottom block shows meso-economic indicators.

The remainder of this section is organized as follows. Subsection 3.4.1 explores the empirical results of the first two simulations. Next, Subsection 3.4.2 analyzes the model results for the exchange depreciation and investment shocks. Finally, Subsection 3.4.3 discusses the sensitivity analysis experiments and summarizes the results.

3.4.1 Income Transfer Shocks

In this experiment, the income transfer toward formal workers is raised by an amount equivalent to one percent of GDP. This transfer is financed by an income tax on capitalists' income.

At the macroeconomic level, calibration (1) presents the following results. Real GDP grows at 4.9 percent. GDP-deflator grows at 5.1 percent. Additionally, the private

balance ($\frac{S-I}{GDP}$) improves by 0.074 percentage points. Because imports are proportional to output and exports respond to price changes, the external balance with respect to GDP, ($\frac{E-M}{GDP}$), deteriorates following the expansion. It deteriorates by 1.082 percentage points. The economic expansion is triggered by a surge in aggregate demand. In Kaleckian fashion, a redistribution of income from capitalists to workers leads to a rise in aggregate demand and output. This increase in output further increases investment, through the accelerator, which feeds back into higher output expansion. In some special cases, this may lead to a virtuous cycle. The rise in real activity generates enough savings to match the rises in investment. Structuralist calibrated models applied to other countries presented similar macroeconomic results. Arnim and Rada (2011), and Cuesta (1990) found similar macroeconomic results for exogenous changes in nominal wages for Egypt and Colombia, respectively.

At the meso-economic level, the initial redistribution promotes structural change. The modern sector employment share rises; it improves by 2.45 percentage points. The modern sector employment share grows at 5.78 percent, the same growth rate of modern sector GDP so long as labor-output ratio remains constant and overall labor supply is exogenous. The transfer of workers from the subsistence sector, a low labor productivity sector, to the modern sector, a high labor productivity sector, leads to a rise in average labor productivity in the whole economy. With a higher capital-labor ratio and access to capital, the formal sector can make any transferred worker more productive. Labor productivity, ε_n, grows at 4.44 percent. Because of the presence of a steep supply for the subsistence sector good, inflationary pressures emerge. The price of the informal good

increases 23.11 percent. The inflationary process hurts further expansion. In sum, the redistribution creates the sufficient conditions for economic expansion.

Comparing the results of calibration (1) and (2), we see that the sign pattern does not change. Both simulations have economic expansion as their main outcome. GDP grows at 2.89 percent. Price, GDP-deflator, grows at 3.15 percent. As expected, calibration (1) promotes a stronger economic expansion since leakages of the system are reduced. In conclusion, the simulation results suggest that more progressive redistributive policies, back in 2006, could stimulate a stronger economic expansion.

A similar interpretation is behind the results of the second experiment. An income transfer toward subsistence sector labor generates a boost in economic activity. Real GDP grows at 4.63 percent; inflation is 4.64 percent. As before, the external balance deteriorates by 1.022 percentage points while the private balance presents a small improvement, it improves by 0.022 percentage points.

An in-depth sectoral analysis allows us to verify that the consumption expansion promotes a smaller structural change. The modern sector employment share improves, going from 42.4 percent (base year) to 44.71 percentage points. As expected, the migration of workers from the subsistence sector to the modern sector creates higher productivity in the whole economy. Because of a higher capital-labor ratio and easier access to capital, the formal sector is able to make any additional employed worker more productive. Labor productivity in the subsistence sector grows at 4.18 percent since labor in this sector is assumed to be redundant.

Although this sector has not been recognized as strategic in the standard literature, according to the simulation result, it has a high capacity to stimulate economic activity. In

a certain degree, the positive result occurs because informal goods inflation is translated into higher informal wages, leading to further expansion, whereas the opposite occurs in the case of income redistribution toward modern sector workers. Moreover, the simulation result relies on specific parameter values.[8]

To summarize, it is interesting to detect that both sectors have strategic roles. The formal sector is important and governmental policies should focus on ways to improve this activity without losing sight of the subsistence sector. The government should consider policies that impact positively both sectors, since they are strongly connected. Improvements in the labor productivity of the subsistence sector are required to achieve a sustainable expansion. The simulation results, therefore, suggest that more progressive redistributive policies, back in 2006 and now, could stimulate a stronger economic expansion.

3.4.2 Investment and Exchange Rate Shocks

Real investment is raised by an amount equivalent to one percentage point of GDP in this experiment. The last two columns of Table 26 reveal the detailed numbers. Let us begin with the first calibration that turns off trade price elasticities.

At the macroeconomic level, real GDP grows at about 2.7 percent and price grows at 2.36 percentage points. The private and external balances with respect to GDP deteriorate by 0.051 and 0.592 percentage points, respectively. An increase in investment leads the economy into a demand-driven expansion. This demand expansion leads to labor transfer, output expansion and inflation.

[8]Depending on different parameter values, the model may present instability problems. For income transfers and investment shocks above 5 percent of GDP, the system becomes unstable.

The exogenous shock causes structural change. Higher demand for the modern sector good stimulates production and labor demand. The modern sector employment share improves by 1.313 percentage points. The labor transfer from the subsistence sector to the modern sector creates higher productivity in the whole economy. Labor productivity, ε_n, grows at 2.33 percent. Because of the presence of a steep supply for the subsistence sector good, inflationary pressures emerge. In structuralist fashion, it is mainly caused by a relatively unresponsive supply of subsistence sector good.

Comparing the results of the two calibrations, we detect that the sign pattern does not change. As before, calibration (1) generates a stronger economic expansion because leakages of the system are reduced. In short, the simulation result suggests that a more progressive policy that promotes investment, such as industrial policy, back in 2006, could lead to a robust process of economic expansion.

Now let us turn the attention toward exchange rate depreciation. According to calibration (1), an exchange depreciation shock causes output contraction. A contractionary depreciation might be caused by many factors; for instance, capital goods imports might be price inelastic in some developing countries. This is a tight constraint for many low and mid-income countries. Another possible factor is that depreciation may cause a considerable reduction on real wages, consequently, reducing consumption. Krugman and Taylor (1978) present a detailed discussion of these factors. Moreover, Taylor (1983) applied a five sector Structuralist calibrated model for India. He detected that exchange depreciations might generate contractionary results. In the Indian context, the depreciation rises imports, which drives up the intermediate costs of the industrial sector. This increase in costs triggers higher final prices of the modern sector good,

reducing the real wages of the modern sector workers and aggregate demand. Since the industrial sector clears by changes in quantities, the modern sector output falls.

Table 26 shows that post shock the economy goes into a situation characterized by output contraction, deflation, and real depreciation. GDP grows at a negative rate of 0.27 percent. At the same time, prices present a negative growth rate of 0.25 percent. Private and external balances have a small deterioration; they decline by 0.066 and 0.008 percentage points, respectively. Following the exchange depreciation, real income and overall savings fall, which leads to a labor transfer from formal to informal sector. This labor transfer causes a reduction in the labor productivity of the whole economy. In this context, labor productivity in the subsistence sector declines by 0.3 percent. Since wages in the subsistence sector, w_n, are a function of subsistence sector's labor productivity, there is a real wage fall for subsistence workers. This wage reduction has a negative impact on consumption, leading to further decreases in output.

Using the results of calibration (2), we detect that exchange depreciation leads to economic expansion and inflation. Real GDP grows at 0.48 percent and inflation grows at 0.39 percent; the modern sector employment share improves by 0.218 percentage points. Labor productivity grows at 0.38 percent. Comparing the two calibrations, there is a clear change in pattern. It seems that there is a threshold, in terms of trade price elasticities, beyond which further depreciations become expansionary. A similar sign change was found for Egypt by Arnim and Rada (2011). Furthermore, Cuesta (1990) applied a Structuralist Calibrated model for Colombia that shows the same pattern; that is, exchange depreciation up to certain point is contractionary.

In conclusion, the lesson is that exchange rate policies should be implemented in a

cautious way since real wage reductions might lead the economy into a recession. These results are in line with the structuralist literature (see Krugman and Taylor 1978, Taylor 1983, and Taylor 1990). In Subsection 3.4.3, we will be able to investigate this shift in pattern in more detail.

3.4.3 Sensitivity Analysis Experiments and Summary

Figure 5 presents the results. There are four panels. Panels (a) and (b) show, respectively, the results for an income transfer toward formal labor and an income transfer to informal workers. Beside panels (a) and (b), panel (c) and (d) reveal the results for five percent and one percent exchange rate depreciation, respectively. The vertical axis reveals the real GDP growth, the horizontal axis shows the trade price elasticity range ($0 \leq \phi, \chi \geq 0.8$) .

The results for panels (a) and (b) suggest that the higher the trade price elasticities, the lower is the growth rate of output. These results make perfect sense since the demand shock is translated into inflation, lower exports and higher amount of imports. Although the expansion loses part of its force, the result remains relevant.

As expected, the results for panels (c) and (d), show that, after the shock, there is a clear sign pattern change. For both simulations, there is a clear threshold, $\chi, \phi \approx 0.23$ percent, beyond which depreciation becomes expansionary. Overall, the higher the trade price elasticity, the more the economy expands at decreasing rates.

In summary, the model's results reveal that redistributive policies may generate the initial conditions for economic progress. An investment shock causes output expansion and inflation. Furthermore, the model points out that under certain conditions

depreciation leads to contraction and deflation. The simulation results, therefore, suggest that more progressive policies could foster economic activity.

3.5 Concluding Remarks

This paper has introduced an alternative model to investigate whether redistributive policies have the capacity to stimulate the economy. The model also attempts to explain the relationship between the two sectors during expansion.

According to the results of the theoretical model, we suggest that an income transfer toward labor has the potential to generate economic expansion in the short-run. The rise in consumption but also investment, which is expected to be more responsive to higher demand than to the ensuing lower profitability, are responsible for the boost in economic activity. In the long run, redistribution of income might increase labor productivity by helping to improve the health and education of workers (Ranis and Stewart 2000).

The empirical results of the four simulations have economic expansion as their main outcome. These results, combined with the fact that the Brazilian government has more policy space to implement different policies, suggest that the economy could grow faster if redistributive policies and industrial policies are applied together. In this sense, the model's results reveal that redistributive policies may generate the initial conditions for economic progress.

Although the model can shed some light on the important structural linkages of the economy, some limitations are presented. The major drawback is that it does not include a financial sector. The financial dimension must be included in further research to

accomplish a better understanding of the process of economic expansion.

The theoretical model and the empirical results, therefore, suggest that income redistribution policies can boost economic activity. Counterfactual experiments suggest that the Brazilian economy could have presented a strongest process of economic expansion during 1990s and thereafter. In sum, an exogenous shock that destroys the perverse relationship between concentration of income and economic stagnation may foster economic expansion.

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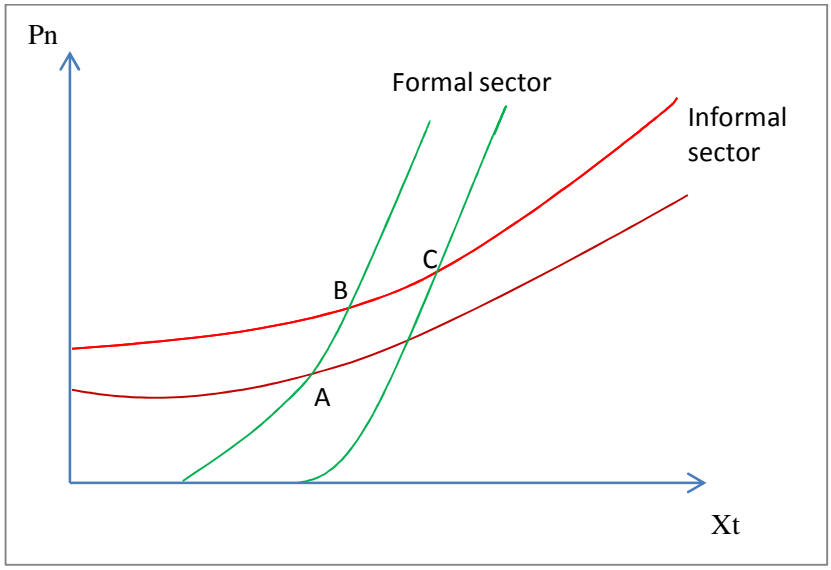

Figure 3: Short-term equilibrium determination in the two sectors.

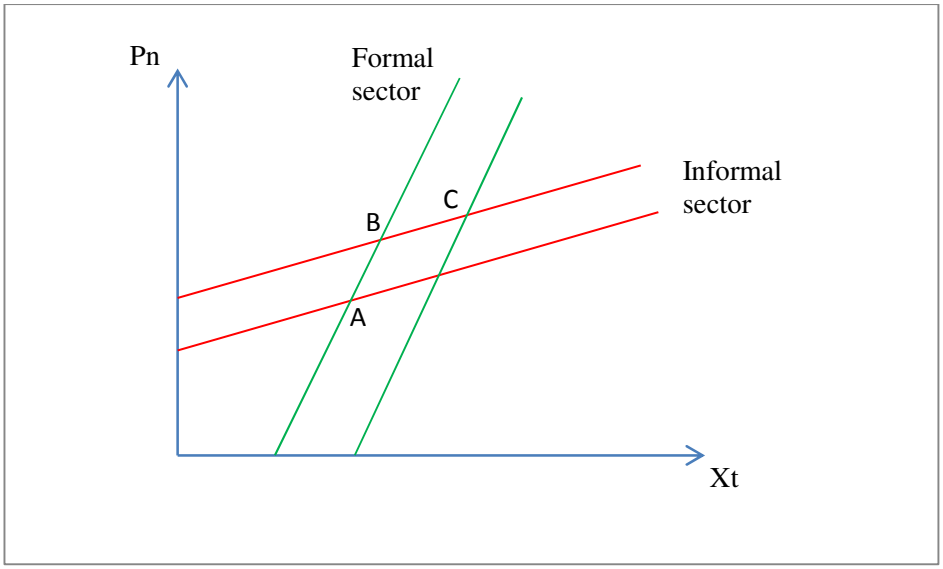

Figure 4: Effects of an increase in income transfer toward modern workers.

Table 24: A schematic social accounting matrix for a two-sector economy.

	Costs		Use of income						
	(T)	(N)	Ywt	Yπt	Ywn	Yf	G	Accumulation	Totals
(T) Modern	Pt att Xt	Pt atn Xn	Pt Ctwt Lt		Pt Ctwn Ln	Pt Et		Pt It	Pt Xt
(N) Subsistence	Pn ant Xt	Pn ann Xn	Pn Cnwt Lt		Pn Cnwn Ln				Pn Xn
Income									
Labor (t)	(1-π)Zt Yt						TRt		Ywt
Profit (t)	πZt Yt								Yπt
Labor (n)		Zn Yn					TRn		Ywn
Foreign	M								Yf
Government				t π Zt Yt					G
Savings				Sπt		Sf		-Pt It	0
Totals	Pt Xt	Pn Xn	Ywt	Yπt	Ywn	Yf	G	0	

Table 25: A social accounting matrix for Brazil.

Costs		Use of Income					
Formal	Informal	Formal HH	Business	Informal HH	Exports	Investment	Totals
1334.10	169.53	737.21		222.48	407.60	448.62	3319.52
226.63	30.97	165.37		57.26			480.23
902.58							902.58
702.34							702.34
	279.73						279.73
153.87							153.87
		0.00	702.34	0.00	-253.73	-448.62	0.00
3319.52	480.23	902.58	702.34	279.73	153.87		

Table 26: Simulation results.

	Transfer to formal workers (1% of GDP)		Transfer to informal workers (1% of GDP)		Exchange rate depreciation (1%)		Investment shock (1% of GDP)	
	1	2	1	2	1	2	1	2
Macroeconomic statistics								
Real gross production growth (%)	5.050	3.072	4.758	2.987	-0.275	0.484	2.705	2.100
Real GDP growth (%)	4.922	2.893	4.638	2.820	-0.349	0.439	2.636	1.990
Inflation (%)	5.150	3.152	4.640	2.884	-0.254	0.395	2.366	1.795
Real exchange rate (Δ in % pts)	-4.895	-3.055	-4.439	-2.803	1.257	0.603	-2.311	-1.763
Private balance (Δ in % points of GDP)	0.074	-0.297	0.022	-0.311	-0.066	0.083	-0.051	-0.244
External balance (Δ in % points of GDP)	-1.082	-1.005	-1.022	-0.958	-0.008	-0.073	-0.592	-0.654
Mesoeconomic statistics								
Real gross production growth (%)	5.780	3.516	5.446	3.419	-0.315	0.554	3.096	2.404
Real GDP growth (Yt) (%)	5.780	3.397	5.446	3.311	-0.410	0.516	3.096	2.337
Inflation (informal good) (%)	23.110	14.014	20.820	12.817	-1.110	1.733	10.505	7.948
Inflation (formal good)	2.637	1.599	2.377	1.463	-0.126	0.197	1.199	0.907
Employment share (formal sector) (Δ in % pts)	2.453	1.441	2.309	1.404	-0.174	0.218	1.313	0.991
Labor productivity growth (informal sector)	4.440	2.565	4.180	2.498	-0.302	0.381	2.333	1.751

Columns (7 and 8) consider investment as an exogenous variable while in the other columns we have the investment endogenous.

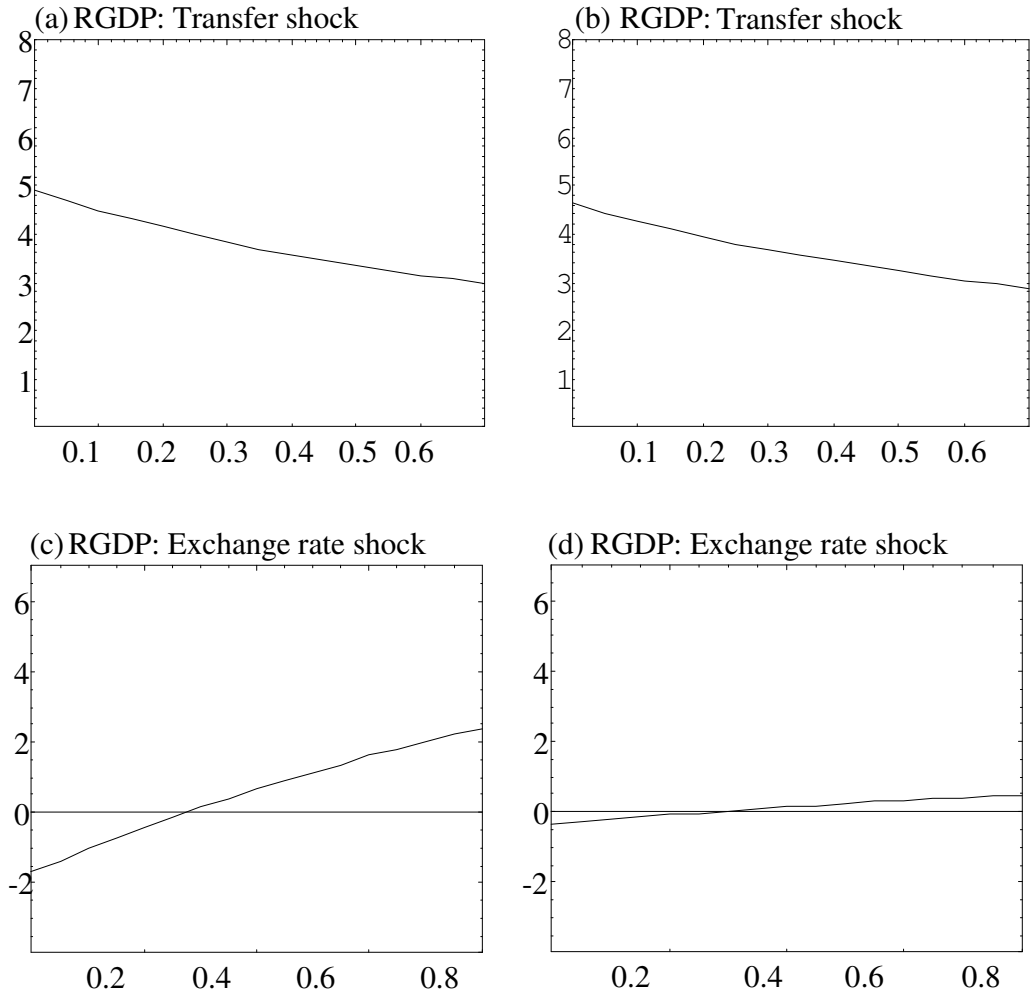

Figure 5: Sensitivity of model results. Trade elasticity varying for the interval [0, 0.8]. Panel (a) shows the results for an income transfer toward formal sector workers while Panel (b) shows the result for an income transfer to informal sector workers. Finally, Panels (c) and (d) show the result of an exchange rate depreciation of 5% and 1%.

3.7 Appendix: Detailed Description of the Model

3.7.1 Endogenous Variables

X_t : gross production (supply) of the high productivity sector;

Y_i : real GDP, i=n,t;

ρ : real exchange rate;

ν_i : share of domestic value added in supply, i=n,t.

ε_t : labor productivity in the subsistence sector;

P_n : price of subsistence good;

Zn : informal sector value added price;

Zt : formal sector value added price;

DY_i : disposable income, i=w_t,w_n.

C_i : consumption, i=n,t.

S_g : governments savings;

S_f : foreign savings;

S_π : capitalist savings;

I_t : investment in the modern sector;

κ : sectoral import propensity;

P_y : GDP-deflator;

Π : profit.

3.7.2 Exogenous Variables

a_{ij} : technical coefficients, i=n,t, j=n,t;

X_n : gross production of the low productivity sector;

X_f : foreign demand;

w_t : wage in the high productivity sector;

P_t : price of tradable good;

w_n : wages in the low productive sector;

b_t : labor-output ratio in the modern sector;

b_n : labor-output ratio in the subsistence sector;

L : total labor, i=t,n;

π : profit share;

γ : markup rate;

TR_t : income transfer to workers in the high productivity sector;

TR_n : income transfer to workers in the low productivity sector;

t_i : capitalist income tax or proportion of capitalist income that goes to workers, i=n,t;

E_t : exports of the high productivity sector.

3.7.3 Parameters

a : share of imported inputs in the output;

s : marginal propensity to save;

z_0 : autonomous investment or animal spirits;

z_1 : coefficient that measures the effect of profit on investment;

z_2 : accelerator coefficient;

e : nominal exchange rate;

α : fraction of income spent in the modern good from modern sector workers;

β: fraction of income spent in the modern good by workers in the subsistence sector;

p^*: price in terms of foreign currency;

ϕ: price elasticity of imports;

χ: price elasticity of exports;

θ: floor-level consumption of the subsistence good.

3.7.4 Modern Sector Price

Below we have the equation that reveals the price in the modern sector. The price depends on inputs, a_{tt} and a_{nt}; subsistence price, P_n; value-added price of the modern sector, Z_t; share of value-added in supply, ν_t; and imported inputs, $eP^* f$.

$$P_t = \frac{a_{nt}P_n + \nu_t Z_t + fe}{1 - a_{tt}} \tag{3.34}$$

3.7.5 Total Disposable Income by Class

As we indicated before, we have in our model three classes plus foreign income. Workers do not save while capitalists do not consume. Capitalists face no trade-off between consumption and savings. In this case, they save all their income. The equations below show that workers' incomes are a positive function of wages and transfers. The transfer is financed by an income tax on capitalists' income, t.

$$DY_{wt} = (P_t C_{wt}^{\ t} + P_n C_{wt}^{\ n})L_t = (1-\pi)Z_t Y_t + TR_t L_t \tag{3.35}$$

$$DY_{wn} = w_n b_n Y_n + TR_n L_n \tag{3.36}$$

$$DY_{\pi} = (1 - t_t - t_n)(\pi Z_t Y_t) \tag{3.37}$$

$$DY_f = eP^* fX_t \tag{3.38}$$

3.7.6 Consumer Demand Equations

Consumer demand functions for both goods are derived from the utility maximization process at the individual level. Workers consume a minimum floor-level, θ, which is insensitive to income and prices. The lower the floor-level consumption of the subsistence good, the higher the demand level for the modern good.

$$D(c_{wt}^{\ n}) = \frac{(1-\alpha)(Z_t w_t + TR_t)}{P_n} + \alpha\theta \tag{3.39}$$

$$D(c_{wt}^{\ t}) = \frac{\alpha(Z_t w_t + TR_t - P_n\theta)}{Pt} \tag{3.40}$$

$$D(c_{wn}^{\ t}) = \frac{\beta(w_n + TR_n - P_n\theta)}{P_t} \tag{3.41}$$

$$D(c_{wn}^{\ n}) = \frac{(1-\beta)(w_n + TR_n)}{P_n} + \beta\theta \tag{3.42}$$

3.7.7 Foreign and Domestic Savings

$$S_f = eP^* fX_t - P_t E_t \tag{3.43}$$

3.7.8 Capitalist Saving

$$S_\pi = DY_\pi = (1-t_t-t_n)(\pi Z_t Y_t) \tag{3.44}$$

3.7.9 Saving-Investment Balance

The equation below shows the equilibrium between saving and investment.

$$S_\pi + S_f = P_t I_t \tag{3.45}$$

If we include eq. 3.23, 3.36 and 3.37 into equation 3.38 and divide by Ph, we get:

$$(1-t_t-t_n)\pi\frac{Z_t}{P_t}Y_t + e(P^*/P_t)aX_t - E_t - z_0 - z_1\pi Y_t - z_2 Y_t = 0 \tag{3.46}$$

The closure of the model is Keynesian, that is, investment is triggered by changes in output. In other words, the investment should change to accommodate changes in aggregate demand. In this way, investment is not a function of savings and the system is demand-led.

3.7.10 Government Savings

Government is always supposed to be in a balanced budget position. The only governmental task is to impose a tax on profits that will be transferred to workers in the form of income transfers. In this way, transfers will be equal to tax revenue.

$$S_g = t_t \pi Z_t Y_t + t_n \pi Z_t Y_t - TR_t L_t - TR_n L_n = 0 \tag{3.47}$$

Labor-output ratio

$$b_t = L_t / X_t \tag{3.48}$$

3.7.11 The Demand Functions

The equation below reveals the maximization process to find the individual demands for each good. We extend the individual demand to the aggregate level as it is usually treated in microeconomics textbooks.

$$U = \sum_{i=h,l} \beta_i log(c_{wn} - \theta) \tag{3.49}$$

The parameter θ is the autonomous consumption for the subsistence good, that is, the consumption that is insensitive to changes in income. The first condition is that $\sum\beta_i = \beta_t + \beta_n = 1$. In this way, $\beta_t = \beta$ is the fraction of income spent on the modern sector good while $\beta_n = 1-\beta$ is the share spent on the subsistence good.

Equation 3.43 is the budget constraint where c_w stands for consumption at the individual level.

$$TR_n + w_n = P_t c_{wn}^{\ t} + P_n c_{wn}^{\ n} \tag{3.50}$$

Workers maximize their utility subject to the budget constraint.

$$Lagrangian = (1-\beta)log(C_{wn}^{\ n} - \theta) + \beta log(C_{wn}^{\ t} - \theta) - \lambda(P_n C_{wn}^{\ n} + P_t C_{wn}^{\ t} - w_n - TR_n)$$

(3.51)

$$D(c_{wn}^{\ t}) = \frac{\beta(w_n + TR_n - P_n\theta)}{P_t} \tag{3.52}$$

$$D(c_{wn}^{\ n}) = \frac{(1-\beta)(w_n + TR_n)}{P_n} + \beta\theta \tag{3.53}$$

The same approach is used to find the demand functions of the modern sector. Instead of β we use α to show the fraction of income spent on goods. We consider $\sum\alpha_i = \alpha_t + \alpha_n = 1$. In this way, the fraction of the modern sector's income spent on the

modern sector's good can be recalled as $\alpha_t = \alpha$ while the share spent on the subsistence good is $\alpha_n = 1-\alpha$. The utility function was transformed into logs so α is an elasticity.

$$U = \sum_{i=t,n} \alpha_i log(c_{wt} - \theta) \tag{3.54}$$

$$L = (1-\alpha)log(C_{wt}^{\ n} - \theta) + \alpha log(C_{wt}^{\ t} - \theta) - \lambda(P_n C_{wt}^{\ n} + P_t C_{wt}^{\ t} - w_t - TR_t)$$

(3.55)

$$D(c_{wt}^{\ n}) = \frac{(1-\alpha)(w_t + TR_t)}{P_n} + \alpha\theta \tag{3.56}$$

$$D(c_{wt}^{\ t}) = \frac{\alpha(w_t + TR_t - P_n\theta)}{Pt} \tag{3.57}$$

3.7.12 <u>The Jacobian Matrix and Conditions for Local Stability</u>

The matrix below, which is called the Jacobian matrix, is a matrix of partial derivatives of excess demand functions with respect to P_n and X_t. A sufficient condition for local stability is that the Jacobian matrix should have a negative trace and a positive determinant.

Local stability implies that the system converges to a stable equilibrium after an exogenous shock. If the two eigenvalues are negative it implies that the determinant is positive and the system is stable.

$$\begin{pmatrix} \dfrac{-(1-\alpha)(Z_t\nu_t X_t+TR_t)-(1-\beta)((-a_{t_n}X_n)\dfrac{(\nu_t Z_t+fe)}{1-a_{t_t}}+TR_n)}{P_n^2} & (a_{n_t}-b_t\nu_t(\beta\theta_n-\alpha\theta_t)+\dfrac{(1-\alpha)(Z_t\nu_t)}{P_n}) \\ \dfrac{-\alpha\theta_t b_t\nu_t X_t+\beta(1-a_{n_n})X_n-\beta\theta_n(L-b_t\nu_t X_t)}{\dfrac{(a_{n_t}P_n+\nu_t Z_t+fe)}{1-a_{t_t}}} & -1+a_{t_t}+\nu_t(z_2+z_1\pi)+\dfrac{\alpha(Z_t\nu_t-Z_t\nu_t\pi-P_n\theta_t b_t\nu_t)+\beta P_n\theta_n b_t\nu_t}{\dfrac{(a_{n_t}P_n+\nu_t Z_t+fe)}{1-a_{t_t}}} \end{pmatrix}$$

We can clearly see above that the system has a negative trace because the main diagonal of the Jacobian matrix is composed by two negative components. However, it is not clear if the determinant is positive or negative. More information is needed to conclude that the system is locally stable. Using the SAM's base year information, we may conclude that the trace of the Jacobian is negative and the determinant of the jacobian is positive. The sign of the elements of the Jacobian is presented below.

$$J=\begin{pmatrix} (-) & (+) \\ (+) & (-) \end{pmatrix}$$

The equations below show the procedure to find the effect of income transfers on economic activity and subsistence price, P_n. The results are below:

$$[J]\begin{pmatrix} \partial P_n/\partial TR_t \\ \partial X_t/\partial TR_t \end{pmatrix}=\begin{pmatrix} -(1-\alpha)/P_n \\ -\alpha/P_t \end{pmatrix}$$

$$\partial P_n/\partial TR_t=det\begin{pmatrix} \dfrac{-(1-\alpha)}{P_n} & (+) \\ \dfrac{-\alpha}{(antP_n+mtZ_t+fe)} & (-) \\ (1-att) & \end{pmatrix}/detJ=\frac{((+)-(-))}{(+)}=(+)$$

$$\partial X_t/\partial TR_t = det\begin{pmatrix} (-) & -(1-\alpha)/P_n \\ (+) & \dfrac{-\alpha}{\dfrac{(antP_n + mtZ_t + fe)}{(1-att)}} \end{pmatrix} /detJ = \frac{(+)-(-)}{(+)} = (+)$$