Essays on Exchange Rate and Economic Performance

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This study is based on the doctoral dissertation titled "Essays on Exchange Rate and Economic Performance", which is selected as the winning entry for the Export-Import Bank of India's BRICS Economic Research Annual Citation (BRICS Citation) 2024. The dissertation was written by Dr. Hugo Carcanholo Iasco Pereira, currently Professor, Federal University of Paraná , Brazil, under the supervision of Professor Fabrício José Missio. Dr. Pereira received his doctoral degree in 2021 from the Federal University of Minas Gerais, Brazil.*

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Executive Summary

The exchange rate represents the price of the domestic currency in terms of other foreign currency. As a relative price, associated with the prices of imported and exported goods, this variable is linked with economic performance concerning short-run aspects (as demand growth, jobs creation, inflation) as well as regarding medium and long-run aspects (as income distribution, structural change, the composition of national income in terms of consumption, saving, investment, and net-exports). In this regard, the exchange rate may boost, or hamper, the long-run growth. When used as a policy oriented for the economic development, the exchange rate can trigger important drivers of long-run growth. Yet, when used as a tool merely associated with other aspects – as nominal anchor, policies of artificial risings in real wages (decoupled from the labor productivity growth), the exchange rate can exert a devastating impact on the aforementioned drivers of long-run growth.

Many studies showed the importance of managing the exchange rate as an oriented policy for economic development. There is an extensive literature that indicates robust evidence – theoretically and empirically, that a devalued real exchange rate (RER, henceforth) may exert a positive influence over the long-run growth. Various authors have suggested possible transmission channels through which the RER influences economic development/growth (as it is discussed in detail throughout this study). Making the RER misaligned in relation to its long-run fundamentals (a more competitive RER) sparks a prosperous process of economic development grounded on international competition, exports, capital accumulation and, ultimately, on the labor productivity growth.

However, a development strategy based on pursuing a competitive RER implies making renunciations in the short-run in order to reach a more developed society in the medium and long-run. In the short-run, the inflationary pressures induced by a weak national currency require a lower real wage to do not corrode the gains of international competitiveness via a strengthened inflationary process. Put differently, assuming the existence of a lower and controlled inflation, in the short-run, an exchange rate policy oriented for the economic development reduces consumption, at detriment of a greater investment, saving and exports. In the medium and long-run, nonetheless, into the extent that the labor productivity grows, induced by the greater pace of capital accumulation, it opens the room for greater real wages in a sustainable path, without incurring in a profit-squeeze situation.

It turns out that there is no guarantee that the greater labor productivity growth will be passed on into the real wages in the medium and/or long-run. There might well be that the fruits of the economic development are not shared equally in the medium and long-run. This applies especially to developing countries, in which the heterogeneous productive structure co-exists with numerous people unemployed, or even engaged in informal activities. In fact, this is the Achilles' heel of this growth-story: there is no guarantee that economic growth, induced by a growth-strategy based on a competitive RER, and its fruits will be shared with all individuals of society in the medium and long-run.

On the other hand, literature suggests that the influence of RER on economic development is not confined to the picture designed above. As a relative price associated with sectoral profitability, the RER is associated with the structural composition of the economy. Pursuing a competitive RER leads to a more industrialized and complex productive structure, benefiting the export sectors. The economy becomes outward-oriented. As a result, the external constraint eases as exports increase and the productive structure becomes less dependent on imports and oriented to produce export goods more sophisticated. Moreover, by making the national firms to compete with the more efficient foreign firms in international markets, this development-strategy leads to national firms more efficient and productive.

It was considering this growth-narrative that this study has been thought. The main goal was to study the effects, theoretically and empirically, of pursuing a competitive RER, as an economic policy, on the economic development in a broad sense. For the sake of clarity and organization, it should be stressed that the study is structured in five chapters independent of each other. Although each chapter has specific objectives with different subjects of analysis, the common background of the chapters was the idea of measuring and understanding the influence of exchange rate on the economic system.

In the theoretical field, the specific goal was to comprehend the effects of a devalued RER on long-run growth from the Kaldorian point of view. The novelty was to understand this relation via the natural growth rate of economy, and not via the actual growth rate (Thirlwall's law), as it is usual in this literature. The Kaldorian approach developed in this study comprehended that the influence of RER on economic growth occurs through the interaction between demand growth and labor productivity growth, considering the intensity of the Kaldor-Verdoorn mechanism endogenous to the technological progress induced by devaluations of RER.

The justification for this new theoretical framework derived from the fact that the usual approach, in the Kaldorian growth theory, accounts for the effects of the RER on the growth in terms of Thirlwall's law. The fundamentals of long-run growth, in this perspective, come down to the magnitude of income-elasticities of exports and imports. Various studies have explored the endogeneity of the income-elasticities in relation to aspects of the supply-side. In particular, a large body of this literature has endogenized the long-run growth fundamentals of Thirlwall's law, concerning the changes in productive structure induced by the RER. The argument is that pursuing a competitive RER promotes a structural change towards the manufacturing sectors. This process increases the importance of the more complex and modern sectors within the productive structure, increasing (reducing) the income-elasticity of exports (imports).

It turns out that Thirlwall's law provides a limited comprehension of the effects of RER on growth (as discussed in detail in the study), even though

it is worth noting an important aspect of Thirlwall's law. This approach does not explain economic growth by its own. As indicated by the structuralist literature, the growth rate of output consistent with the equilibrium in balance of payment is more a consequence of the drives behind the long-run growth than its cause. The main elements that determine the long-run growth are in the supply-side of the economy, in the Kaldorian sense. It is the interaction between demand growth and labor productivity growth that determines the long-run growth. Thirlwall's law simply explains the maximum growth of output consistent with the equilibrium in balance of payment. It is in this regard that the theoretical contribution of this thesis is grounded on: understanding the influence of RER on long-run growth through the supply-side within the Kaldorian approach.

It is noteworthy to stress that the theoretical model developed in this study is more closely related to be a complementary approach than a disowning of Thirlwall's law. Indeed, both perspectives should be taken together. There is no way to boost the long-run growth of an economy under an effective external constraint. The supply-side of the economy (in the Kaldorian sense) requires an ease external constraint in order to act as a boosting vector of long-run growth. However, a growth theory that does not incorporate the supply-side, in the Kaldorian manner, is a meaningless approach because it does not really explain growth.

Motivated by these considerations, the new theoretical approach developed in this thesis sought to understand the effects of pursuing a competitive RER over the long-run growth via the supply-side of the economy (in the Kaldorian way). The argument was that pursuing a competitive RER exerts influence on the long-run growth through two channels: i) by affecting the income distribution and, then, the effective demand growth; ii) by influencing the firms' decisions of making new investments, which changes the intensity of the circular and cumulative causation: i.e., a faster pace of capital accumulation, induced by a competitive RER, enlarges the parameters of the productivity regime (the Kaldor-Verdoorn mechanism becomes more intense). In both cases, pursuing a competitive RER may spur long-run growth under certain conditions.

The theoretical foundation of the study is built on "*Kaldorian Growth Models: a critical discussion*", which discusses the long-run growth in the Kaldorian perspective, with an appointment of an agenda of theoretical research, than an original contribution to literature. The main goal of the analysis was to discuss the long-run growth in the Kaldorian tradition in order to shed light on the limitations of Thirlwall's law to understand the influence of RER on economic growth. The analysis sought to address the following questions: a) *What is the nature of economic growth within the theoretical Kaldorian models*? b) *What are the fundamentals and the shortcomings behind the Kaldorian approach to comprehend the long-run growth?* c) *What are the consequences for the understanding about the influence of RER over the long-run growth when the Thirlwall's law is taken as the theoretical approach?* For this purpose, two groups of models were discussed: i) the export-led growth model à la Kaldor (1970) and Dixon and Thirlwall (1975), and ii) the Thirlwall's law à la Thirlwall (1979), and its main extensions. Special attention was paid to understand how the supply-side is considered, as well as its consequences for a growth theory that aims to explain the influence of RER on growth.

The first chapter, "*Endogenous Productivity Regime and the Impact of Devaluations of Real Exchange Rate on Economic Growth*", is an original contribution to the theoretical literature. The leading question of this chapter was: *What is the effect of devaluations of RER over the long-run growth in a Kaldorian growth model of cumulative and circular causation when the productivity regime is endogenous regarding the RER*? The new approach endogenized the parameters of the productivity regime to capture the influence of RER over the capital accumulation/technological progress on the labor productivity with the demand growth. The argument was that the RER impacts labor productivity growth and the intensity of the Kaldor-Verdoorn mechanism by influencing firms profit rate and, then, its investment decision.

The contribution of this study to the existing literature was not limited to theoretical discussion. In the empirical field, the thesis tested the influence of RER on the economy from a broad perspective. A specific goal was to study empirically the direct impact of pursuing a competitive RER on the long-run growth. For that, the second chapter, "*Exchange Rate and Growth: empirical*

evidence (1995-2018)", studied the empirical association between the RER and economic growth. The studied problems of this chapter were: a) *Are the devaluations of RER associated with a greater long-run growth*? b) *Could this possible association be different if the exchange rate misalignments were calculated using different fundamentals*? c) *Could this possible association be different for countries classified in accordance with the income-level, or by different countries' samples*? d) *Is the Washington Consensus' view on the relation between misalignments of RER and growth valid*? e) *Does the influence of RER on growth follow a non-linear pattern*? Various econometric models and specifications were estimated using various measures of RER misalignments with different fundamentals.

The remaining specific goals of this study are associated with testing the influence of pursuing a competitive RER on drivers of long-run growth. In other words, it tested the indirect influence of a competitive RER on long-run growth. Specifically, it tested its effects on i) the structural change (the importance of manufacturing, services and primary activities within the productive structure, and economic complexity), ii) the sectoral performance in terms of job creation, iii) the costs of pursuing a competitive RER in terms of the pass-through onto the manufacturing prices, iv) income distribution (functional and personal), v) the composition of national income in terms of investment, consumption/saving and the performance of net exports, vi) and, lastly, over the economic efficiency represented by the social capability and Total Factor Productivity. Thus, the remaining three chapters of this study are empirical.

The third chapter, "*Exchange Rate and Structural Change: a study using aggregated and sectoral data*", tested the association between the RER and structural change using both aggregated as sectoral database. The basic questions addressed by this chapter were: a) *Why does the RER matter for the composition of productive structure*? b) *How does the RER influence the structural change*? c) *Are the devaluations of RER a driver of the structural change towards an industrialized and more complex productive structure*? *d) What is the influence of RER over the sectoral performance in terms of job creation for developing countries*? e) *Are the degree of outward-orientation,*

technological regime and labor costs of the sectors associated with such possible influence? The results suggested that a competitive RER promotes a structural change, mainly towards the manufacturing and more complex activities.

The fourth chapter, "*Exchange Rate and Prices: an extended Kaleckian approach for Brazilian manufacturing sectors (2010-2019)*", investigated the effects of pursuing a competitive RER on the prices of industrial sectors of the Brazilian economy over the period between 2010 and 2019. This chapter was guided by the following research problems: a) *What determines the inflationary effects of exchange rate devaluations using the Kaleckian cost-push approach? and When it is used an extended approach that considers the structuralist idea of neutral inflation*? b) *What are the variables that influence the magnitude of the exchange rate pass-through into prices*? c) *What is the magnitude of the exchange rate pass-through into the prices of manufacturing sectors of Brazilian economy*? d) *What are the explanations for the differences of exchange rate pass-through into the prices across the sectors*? A theoretical model was developed to extend the Kaleckian approach in order to understand the exchange rate pass-through onto prices. The model indicated that the exchange rate pass-through is associated with the share of imported inputs/wages in all costs, the influence of RER over the mark-up rate, and structural composition of the economy. The time-serials evidence indicated that a competitive exchange rate has costs in terms of inflation, even that this influence is partial and varies across the sectors.

The fifth chapter, "*Real Exchange Rate and Growth: identifying transmission channels*", addressed the effects of pursuing a competitive RER on some possible transmissions channels from RER into economic growth. The research problem of this chapter was: a) *How does the income distribution (functional and personal), as well as the composition of national income between investment, saving, consumption and net exports, social capability, and Total Factor Productivity correlate with misalignments of RER? Is this possible correlation different for developing countries*? The regressions indicate that pursuing a competitive RER worsens the functional income distribution, while it reduces the income inequality in terms of the personal income distribution.

Plus, the results also suggested that pursuing a competitive RER makes the consumption smaller to the detriment of a larger saving/investment and boosts the net exports directly and indirectly (via the smaller labor costs). The study also revealed that increases in the social capability and productivity growth are associated with a competitive RER.

After the discussion on the scope and design of the study, next sections briefly present the main study findings organized by chapter.

1. Endogenous Productivity Regime and the Impact of Devaluations of Real Exchange Rate on Economic Growth

Various studies confirmed the positive impacts of devaluations of the real exchange rate (RER) on economic growth (e.g., Acemoglu *et al*., 2003, Easterly, 2001, Rodrik, 2008, Gala, 2008, Vieira and MacDonald, 2012, Rapetti *et al*., 2011). Usually, the Kaldorian literature explains it in terms of the balance of payment constraint growth models à la Thirlwall (1979).

A usual argument of the authors of this literature is the endogeneity of the income-elasticity of exports regarding the effects of RER on the productive structure. The argument is that a competitive RER favors manufacturing activities. As a result, the sectoral composition of income-elasticities of exports changes, in the sense that the share of manufacturing (more complex) goods in exports expands. As the income-elasticity of exports of these sectors are more significant, the consequence is a greater growth rate of output consistent with the equilibrium in balance of payment (Ferrari *et al*., 2013, Missio at al., 2017a,b are examples of this literature).

The rationale behind this approach is that a competitive RER influences the productive structure, which reflects upon the composition of income-elasticities of exports. As the fundamentals of economic growth are the parameters of external constraint, pursuing a competitive RER becomes a strategy to boost it. Such an approach, therefore, explains the influence of RER on economic growth via the actual growth rate (Thirlwall, 2001, McCombie, 2012). This chapter seeks to study the impacts of RER's devaluations over economic growth via the natural growth rate. The theoretical model, developed in this chapter, assumes that economic growth is demand-led and is characterized by a process of circular and cumulative causation. The

growth rate of demand and labor productivity feed each other à la the canonical growth model of Kaldor-Dixon-Thirlwall (KDT, henceforth) (Kaldor, 1970, Thirlwall and Dixon, 1975). Within this framework, two elements are crucial in determining the possible growth paths: the demand growth and the parameters of labor productivity growth.

The canonical growth model KDT has some shortcomings to study the association between RER and economic growth. The demand is determined uniquely by the exports. The domestic demand is disregarded. It turns out, yet, that the devaluations of RER can exert contractionary effects on economic growth as long it reduces the real wages, damaging the domestic demand (Diaz Alejandro, 1963). In order to remedy it, the paper introduces the domestic demand into the picture in accordance with Bahduri and Marglin (1990). Another important shortcoming of the canonical growth model KDT is the exogeneity of the parameters of the Kaldor-Verdoorn mechanism. Although these parameters are crucial to explain the growth path, they are not explained. This chapter endogenizes the parameters of the Kaldor-Verdoorn mechanism to the institutional regime, as Setterfield and Cornwall (2002) propose.

1.1 A summary of the development of the theoretical model

The growth model developed in this chapter follows the analytical structure of Setterfield and Cornwall (2002), in which economic growth is taken as a cumulative and circular process, and three elements are interwoven that, combined, constitute the macroeconomic regime:

(1) Demand Regime: The demand regime describes the formation of demand growth. The theoretical model of this chapter expands the sources of demand in addition to the exports, considering the domestic sources of demand: investment, consumption, and imports.

(2) Productivity Regime: The productivity regime describes labor productivity growth determinants. The model of this chapter assumes that labor productivity growth is determined by the Kaldor-Verdoorn mechanism.

(3) Institutional Regime: The non-price variables that affect the size of the parameters of Kaldor-Verdoorn mechanism (r_a and λ) constitute the institutional regime. The institutional regime encompasses the macro-institutional structure within the economic behavior that occurs and constitutes the operating system related to the social infrastructure, uncertainty, social conflict, stability, long-run expectations, income distribution claims (Setterfield and Cornwall, 2002). An institutional regime based on the absence (existence) of distributive conflict and uncertainty, concerning the profit-share of GDP and a growing up (slowing down) demand, generates a period of strong (weak) capital accumulation (Setterfield and Cornwall, 2002). Consequently, the parameters r_a and λ are higher (lower), which enhance (diminish) the growth rate of productivity and demand (Setterfield and Cornwall, 2002).

Furthermore, the model is developed assuming that:

(1) The RER is the price of the foreign currency in terms of the domestic currency (it is the price of the national currency to the eyes of the foreign buyer). As lower the RER, the cheaper domestic goods are in the international market. It is assumed that RER is determined exogenously by monetary authority in order to make domestic goods more competitive in relation to foreign goods.

(2) The income distribution between workers and capitalists is the link between RER and demand growth: RER influences consumption (wage-share), investment (profitability), and net exports (international competitiveness).

(3) The productivity regime is endogenous to RER. The argument is that the RER influences the magnitude of parameters r_a and λ via its effects on the investments (that embodies technological progress). That is, the intensity of Kaldor-Verdoorn mechanism is endogenous to the RER.

The theoretical model was developed following the subsequent steps. Firstly, the link between RER, prices and income distribution is modeled. Then, the demand and productivity regimes were modeled, connecting RER, income distribution, demand, and labor productivity growth.

1.2 Main findings

From the demand side, the influence of RER on economic growth is associated with the regime of demand. Devaluations of RER, in economies under a profit-led regime, positively impact the growth rate of demand and labor productivity. Nevertheless, in economies under a wage-led regime, the effects of RER devaluations are not straightforward. Its influence depends on which effect prevails: its direct contractionary effects on demand growth or its indirect expansionary effect on demand growth via its negative influence on labor productivity (that exerts a positive influence on wage-share in GDP). If the first effect prevails, devaluations of RER reduce the growth rate of demand and labor productivity. However, if the second effect prevails, devaluations of RER boost the growth rate of demand and labor productivity.

From the supply side, the influence of RER on economic growth is associated with the regime of capital accumulation. The model endogenized the parameters of productivity-regime regarding capital accumulation (which embodies technological progress). As faster is the pace of capital accumulation, the greater the autonomous productivity growth is. Moreover, the intensity of the Kaldor-Verdoorn mechanism also depends on capital accumulation, which means the RER influences the magnitude of the effect of growing demand on labor productivity. The demand growth is still the primary determinant of labor productivity. The RER influences labor productivity by changing productivity-regime parameters via its effects on capital accumulation/technological progress. In this regard, devaluations of RER in economies under a profit-led regime boost capital accumulation, which positively impacts labor productivity: the autonomous productivity increases, and the Kaldor-Verdoorn mechanism becomes more intense. In contrast, devaluations of RER in economies under a wage-led regime damage the capital accumulation, which negatively impacts labor productivity: the autonomous productivity reduces, and the Kaldor-Verdoorn mechanism becomes less intense.

As a circular and cumulative causation process, the impact of devaluations of RER on economic growth is associated with the interaction between the demand-side and supply-side factors. The model has shown that devaluations of RER:

(i) In economies under a profit-led regime of demand and capital accumulation, expand the demand growth, which, via the Kaldor-Verdoorn mechanism, increases labor productivity growth. In addition, the devaluations of RER induce a faster pace of capital accumulation/ technological progress. Thereby, autonomous productivity increases and the Kaldor-Verdoorn mechanism becomes more intense, reinforcing the expansionary cycle. Therefore, the impacts of devaluations of RER on economic growth, in this case, are positive.

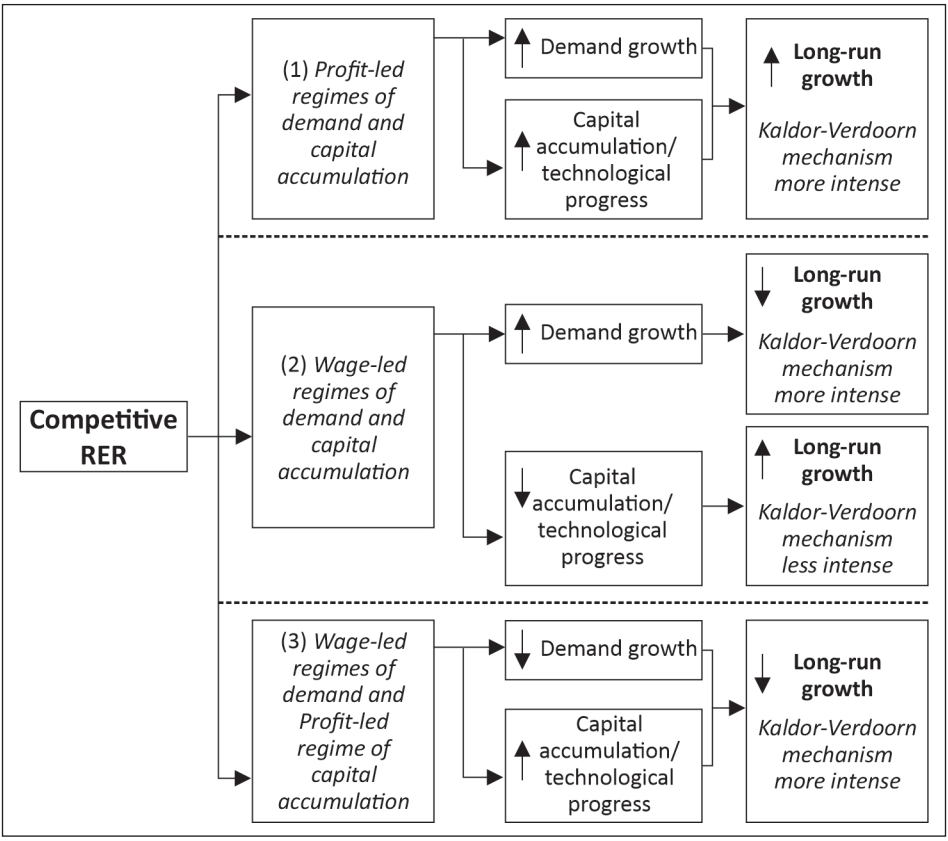
(ii) In economies under wage-led regimes of demand and capital accumulation, if the contractionary effects on demand growth prevail (first scenario), shorten the demand growth. Moreover, the devaluations of RER induce a slower pace of capital accumulation/technological progress in a way that the autonomous productivity reduce, and the Kaldor-Verdoorn mechanism becomes less intense, counterbalancing the contractionary process. Therefore, the impacts of devaluations of RER on economic growth, in this case, are negative. Nevertheless, it should be highlighted that making the parameters of the productivity regime endogenous to RER, implies a better situation after devaluations of RER, when compared to the situation in which the productivity regime is exogenous. In contrast, if the expansionary effects of RER devaluations on demand growth via its negative influence on labor productivity (that exerts a positive influence on wage-share in GDP) prevails (second scenario), devaluations of RER exert a positive influence on demand growth. Once again, the devaluations of RER induce a slower pace of capital accumulation and technological progress, reducing the autonomous productivity and the intensity of the Kaldor-Verdoorn mechanism. Into the extent that the labor productivity lowers (the wage-share in GDP increases), the economic growth accelerates. Therefore, the impacts of devaluations of RER on economic growth, in this case, are positive.

(iii) In economies under a wage-led regime of demand and a profit-led regime of capital accumulation, in the first scenario, shorten the demand growth. Furthermore, RER devaluations induce a faster pace of

capital accumulation/technological progress. In this way, autonomous productivity increases, and the Kaldor-Verdoorn mechanism becomes more intense, reinforcing the contractionary process. In the second scenario, RER devaluations boost the demand growth, but the increases in labor productivity induced by the RER devaluations damages economic performance. Therefore, the impacts of devaluations of RER on economic growth, in both cases, are negative. It should be highlighted that making the productivity regime endogenous worsens economic performance after RER devaluations, compared to the situation in which the productivity regime is exogenous.

Figure 1.1, presented below, illustrates the main findings of the theoretical model.

Figure 1.1- A summary of theoretical results



1.3 Conclusions

This chapter proposed a growth model, within the Kaldorian tradition of circular and cumulative causation, to study the influence of RER devaluations on economic growth, solving some limitations of the canonical KDT growth model on this issue. The most interesting characteristic of this model is the fact that it explicitly considers the RER, whilst its influence on economic growth occurs via both demand-side as supply-side factors. The chapter's contribution to the existing literature are twofold. First, the chapter provides a growth model of cumulative and circular causation, in which the RER influences the growth path by the demand-side and by the supply-side factors. The influence of devaluations of RER on economic growth, via the demand-side, is associated with the regime of demand. The influence of RER's devaluations on economic growth, via the supply-side, is connected with the influence of RER on capital accumulation, which affects the parameters of the Kaldor-Verdoorn mechanism. In this scheme, the demand-growth remains the primary determinant of labor productivity. The capital accumulation induced by the RER appears as an argument that influences the degree of cumulative and circular causation of economic growth. Such contribution means that the labor productivity depends on the demand growth à la Verdoorn (1949) and Kaldor (1966) as on the capital accumulation à la Kaldor (1957) (Ros, 2015). Second, the chapter displays that, in economies under profit-led regimes of demand and capital accumulation, the more intense degree of cumulative and circular causation induced by RER's devaluations boost economic growth. The chapter also shows that, in economies under wage-led regimes of demand and capital accumulation, the less intense degree of cumulative and circular causation induced by devaluations of RER can exert a positive influence on the economic growth, under certain assumptions. The chapter demonstrates that the more intense degree of cumulative and circular causation induced by RER's devaluations damage economic growth, in economies under a wage-led regime of demand and a profit-led regime of capital accumulation.

2. Exchange Rate and Growth: Empirical Evidence (1995-2018)

The exchange rate is a relative price that represents the price of domestic currency in terms of other national currency. In recent years, a growing literature has shown empirical evidence pointing out that the exchange rate is not neutral for economic growth. However, the exchange rate has been the subject of controversy in economic growth models (Schröder, 2013). On the one hand, the exchange rate is disregarded in mainstream growth models – elaborated for closed economies as Solow's model and endogenous growth theories (Schröder, 2013). On the other, two opposite views compete concerning the best exchange rate policy for economic growth (Schröder, 2013).

The Washington Consensus view claims that any misalignment of the exchange rate from its equilibrium situation hurts growth (Williamson, 1990). An overvalued exchange rate leads to crises in the balance of payments that requires the "stop-and-go" strategy to reduce imports or import controls (Berg, 2010). However, an exchange rate strongly competitive produces inflationary pressures that reduce investment, which curbs potential output growth (Willianson, 1990). Although, an overvalued domestic currency is worse than an undervalued, economic growth is associated with maintaining the exchange rate at equilibrium (Schröder, 2013).

The opposite view claims that an overvalued exchange rate hurts economic growth, whilst a devalued currency boosts it. It is identified some mechanisms in theoretical literature to explain such a relationship. In export-led economic growth models (e.g., Kaldor, 1970, Dixon and Thirlwall, 1975), an exchange rate policy that keeps a stable and devalued exchange rate may work as

an engine, promoting growth as it increases exports' competitiveness. The effects of this outward orientation policy go further as it reduces risks, shorter investment horizons and benefits the tradable sectors, which, to an extent, explains the reasons why Asian countries have grown more rapidly than Latin America and Africa ones (Sachs, 1985, Cavallo at al, 1990, Dollar, 1992). Another strand states that the exchange rate drives capital accumulation by changing income distribution in favor of real wages (overvaluations) or profit-margin (devaluations) (Blecker, 1989, Bahduri and Marglin, 1990). Within profit-led economies, reductions in real wage – generated by exchange rate devaluations or not, boost output growth. The *rationale* behind it is that the reductions in labor costs increase the competitiveness of tradable sectors and then boost exports. The effects are broader, exchange rate devaluations – by increasing companies' revenue and cutting real wages - increase internal funds of firms to finance new investments.

The distributive effects of exchange rate favor differently the sectors, promoting a structural change towards non-tradable or tradable sectors (Frenkel and Ros, 2006, Rodrik, 2008, Bhalla, 2012 and Ros, 2013, among others). Exchange rate overvaluations favor real wage – consumption, and non-tradable sectors, represented by services. Devaluations, in turn, increase profit-rate – saving and investment, and tradable sectors; as it encompasses industry - the sector with more innovative activities and backward/forward linkages, and increasing returns to scale, devaluations of the exchange rate may promote a structural change *à la* Lewis (1954), Hirschmann (1958) and Kaldor (1957), leading to higher growth rates of *per capita* income. The other growth mechanism is associated with the effects of the exchange rate on income-elasticities of exports and imports within the balance of payment growth models *à la* Thirlwall (1979). Devaluations of exchange rate boost firms' investments in technological progress (by increasing its internal funds), which *ceteris paribus* enlarges the income elasticity of exports and the growth rate of output compatible with external constraint. (Ferrari *et al*., 2013, Missio and Jayme Jr., 2012, Missio *et al*, 2017a). Overvaluations of the exchange rate, in turn, reduce the availability of internal funds to finance investment of firms in technological progress, which leads to higher income elasticity of imports and then to lower growth rate of output compatible with external constraint (Ferrari *et al*., 2013, Missio and Jayme Jr., 2012, Missio *et al*, 2017a).

This chapter seeks to assess the effects of exchange rate movements on long-term growth for a set of one hundred and fifty-one countries over the period 1995-2018. The first step was to construct measures of exchange rate misalignment, which was carried out following the well-established procedure of Rodrik (2008). Various fundamentals suggested by the literature were considered; Balassa-Samuelson effect, net foreign assets, and terms of trade. A novelty of this chapter is the introduction of labor costs as a fundamental of the exchange rate. The argument is that higher (lower) labor costs make the tradable goods more expensive (cheap), leading to real exchange rate appreciations (depreciations).

2.1 Review of Empirical literature

The empirical cross-country literature employs different exchange rate concepts, econometric methods, and databases to assess the exchange rate's effects on economic performance. Most of the empirical literature is focused on explaining the effects of the exchange rate on the long-run growth (growth rate of GDP *per capita*).

Cottani *et al* (1990) assessed the effects of exchange misalignments and exchange volatility in the growth rate of GDP *per capita*, exports, imports, investment, agriculture production, and incremental capital-output ratio for 24 less developed countries over the period 1960-1983 employing cross-sectional regressions. The author concluded that higher exchange volatility and misalignments of real exchange rates hurt all dependent variables' growth rate, except for the capital-output ratio. Dollar (1992) performed cross-sectional regressions to assess the effects of exchange misalignments from the hypothetical free-trade level (trade orientation of economy; outwards or inwards) in the growth rate of GDP *per capita* for 95 less developed countries over the period 1976-1985. The results of Dollar (1992) point out that higher exchange volatility hurts the growth rate of GDP *per capita* and the outward-orientation (trade liberalization, devaluations and stability) is positively associated with higher growth rates.

Razin and Collins (1997) performed regressions in a panel data setting to test the relationship between the real exchange rate misalignment and the

growth rate of GDP *per capita* for 93 countries over the period 1975-1992 (20 developed countries and 73 developing countries). Their conclusions stressed the existence of a non-linear relationship between real exchange rate and growth. Only high over-valuations are associated with slower economic growth and moderated to high (but not too high) under-valuations are associated with a higher economic growth rate. Easterly (2001), in turn, assessed the relationship between exchange misalignment and the growth rate of GDP for developing countries over the period 1980-1998, employing seemingly unrelated regressions. Easterly (2001) concluded that devaluations are associated with higher growth rates.

In a historical perspective, Acemoglu (2005) tested the effects of exchange rate misalignments in the standard deviation of the growth rate of GDP *per capita* (growth volatility) for the countries of Penn World Table over the period 1970-1997 (and the average of each decade) using cross-sectional regressions (OLS and 2SLS) and panel regressions (FE and RE). Acemoglu associates the weak institutions inherited from colonial times (extractive institutions) with distortionary macroeconomic policies, encompassing an overvalued exchange rate (high inflation and budget deficit. The overvalued exchange rate partially explains the high volatility of the growth rate of GDP *per capita*. Acemoglu (2005) concluded that the real exchange overvaluation is used as a method of income redistribution in favor of elites and a self-perpetuating way this elite in the power.

Aguirre and Calderón (2005) estimated the relationship between exchange misalignments and the growth rate of GDP *per capita* for 60 countries over the period 1965-2003 in a panel data setting. The authors pointed out the existence of a negative relationship between exchange misalignment and growth. Besides, they showed that overvaluation and undervaluation adversely affect the growth with different intensity following a non-linear pattern. The higher overvaluation lowest is the growth, while moderate real exchange undervaluations are positively associated to growth rates of GDP *per capita*.

Hausmann, Pritchett and Rodrik (2005) assessed the association between the real exchange rate and the episodes of rapid acceleration in economic

growth for all countries of Penn World Table 6.0 (excluding the countries with a population less than 1 million and with fewer than 20 data points). They assessed this relationship employing cross-sectional regressions for 83 episodes of growth accelerations concentrated in the period between 1957 and 1992. Their conclusions point out that growth accelerations require more investment, exports, and a more competitive exchange rate. In this line, Johnson, Ostry and Subramanian (2007) also tested the existence of an association between the episodes of rapid acceleration in economic growth and the real exchange rate for Sub-Saharan African Countries. They concluded that avoiding real exchange rate overvaluation is essential to escape from poverty and the historical trap of weak institutions as it increases the manufacturing exports.

Gala (2007) performed growth regressions in a panel data set for 58 developing countries over the period 1960-1999 to explain the growth rate of GDP capita. Gala (2007) concluded that exchange overvaluations (devaluations) hurt (boost) the growth rate of GDP *per capita*. Rodrik (2008) performed very similar growth regressions in a panel data set for 184 countries over the period 1950-2004. Rodrik (2008) displayed that exchange overvaluation hurts growth meanwhile undervaluation helps economic growth following a linear pattern. This result is especially valid for developing countries (Rodrik, 2008).

Employing the same sample and estimating procedures of Rodrik (2008), Berg and Miao (2010) concluded that exchange overvaluation hurts growth, and undervaluation helps economic growth following a linear pattern. Besides, the authors showed that different measures of the exchange rate (Rodrik's measure and other specifications that consider other determinants of equilibrium exchange rates) lead to the same obtained results. Following Rodrik (2008) – with the same database and estimating procedures, Rapetti, Skott, and Razmi (2012) concluded that exchange rate undervaluation is stronger correlated and more robust with economic growth in developing countries. Still, they pointed out that this result depends on the GDP *per capita* cut-off that defines the developing countries.

Levy-Yevati and Sturzernegger (2009) associated the monetary authority intervenes to avoid the appreciation of national currency with the growth

of real GDP for 179 countries over 1974-2004. They created two variables to represent this "fear of appreciation" as (i) the interventions of the monetary authority to avoid the appreciation of national currency represented by the annual average of the absolute value of monthly interventions (the average change in net international reserves relative to the monetary base in the previous month) and (ii) the annual change of the ratio between the foreign assets and broad money. Levy-Yevati and Sturzernegger (2009) pointed out that the "fear of appreciation" has a positive effect on growth.

Berg, Ostry and Zettelmeyer (2012) performed regressions to explain the length of sustained growth periods for 140 countries. Their conclusions state that the length of growth periods is negatively associated with external shocks and macroeconomic volatility. On the other hand, the growth periods' length is positively associated with good political institutions and an income distribution more equal. Their results also suggest that the export composition and the real exchange rate matter as the manufacturing exports are associated with a more extensive period of growth, and the avoidance of overvaluation is favorable for the duration of growth periods. Vieira and MacDonald (2012) tested seven different specifications of exchange rate misalignments to explain the GDP growth rate for 90 countries over the period 1980-2004 using regressions in a panel data set. They concluded that a more depreciated exchange rate boosts the economy's growth rate, and the different specifications of exchange misalignments produce different estimates in growth regressions, notwithstanding it leads to similar results.

Schröder (2013) performed regressions in a panel data set to explain the growth rate of GDP capita for 63 developing countries over the period 1970-2007. Schröder (2013) concluded that exchange rate undervaluations hurt growth. Besides, the prescription of Washington consensus, according to which exchange rate's equilibrium position is better to foster growth. However, Schröder (2013) states that this is not a sufficient condition to grow more. A non-misaligned exchange rate is simply a facilitating condition.

Missio *et al* (2015) performed growth regressions in a panel setting for three samples of countries over the period 1980-2008 to understand how the exchange rate affects the growth rate of GDP *per capita*. Their results

state that an undervalued real exchange rate boosts the growth rate. The novelty of their estimates is testing the possible non-linearity using quantile regressions, confirming a non-linear relationship between real exchange rate and growth for countries of average income. Ribeiro *et al* (2020) re-evaluated the relationship between real exchange rate and long-run growth by considering further aspects of income distribution, technological capability within developing countries. The regressions performed by the authors indicated that the exchange rate has not directly influenced the growth of developing countries. Nevertheless, the authors indicate that the exchange rate influences (negatively) the long-run growth through its effects on income distribution and cross-country technological capabilities.

On the other hand, few cross-country studies that assessed the effects of exchange rate movements in other variables associated with economic growth. Bahmani-Oskooee and Hajilee (2010), Razmi and Rapetti and Skott (2012), employing different databases and econometric methods, showed that exchange devaluations have a positive effect on investment. Glüzmann, Levy-Yeyati and Sturzenegger (2012) showed that exchange devaluations reallocate the national income towards investments and savings to the detriment of consumption. Some studies showed that exchange rate devaluations are positively associated with the decisions of investment at the firm-level through different channels (Dao, Minoiu and Ostry, 2017, Avdjiev *et al*., 2018, Brito, Magud and Sosa, 2018), with industrial employment and output of exporting sectors (Galindo al., 2007, Lanau, 2017) and with structural changes towards manufacturing and more complex sectors (Gabriel and Missio, 2018).

In sum, the exchange rate effects on long-run growth are confirmed by empirical literature. Still, the direction and the intensity are not consensual in literature as it can vary according to the database, the different concepts of the exchange rate, empirical methods, samples and specification.

2.2 Exchange Rate Misalignments

This section presents the empirics of measuring real exchange rate misalignments employed in growth regressions. The procedure of Rodrik

(2008) is the benchmark of literature in calculating the real exchange rate misalignments, and it is employed in this chapter. For that, it uses data from World Bank for the real exchange rate (RER):

$$LRER_{it} = L(PPP_{it}/XRAT_{it}) \quad (2.1)$$

where *i* and *t* denote country and time (5-year) index, respectively. The variables PPP_{it} and $XRAT_{it}$ stand for conversion factor and nominal exchange rate, expressed as national currency units per U.S. dollar, (L denotes that variables are in logarithm form). When *LRER* is greater than zero, it means that currency's valor is higher (more appreciated) than the purchasing power parity. Otherwise, when *LRER* is lower than zero, it means that the valor of the currency is lower (more depreciated) than the purchasing power parity.

Following the BEER approach, the fundamentals should be considered to calculate the measures of exchange rate misalignments. Rodrik (2008) calculated it considering the Balassa-Samuelson effect (BS) captured by a regression of RER on *per capita* GDP (PIBCAPITA):

$$LRER_{it} = \alpha + \beta LPIBCAPITA_{it} + f_t + u_{it} \quad (2.2)$$

where f_t and u_{it} are a time fixed effect (5-year) and the error terms. The estimates of Rodrik (2008) provided the estimated coefficient around 0.24 and statistically significant for β, suggesting that increases of 1% in *per capita* GDP increases the valor of national currency by 0.24% (more appreciated). Our estimates of equation (2.2) suggested that β is statistically significant at 1% and equals 0.19. Following Vieira and MacDonald (2012), other variables are introduced in estimates of exchange rate misalignments. Six additional specifications are performed controlling other fundamentals. The data involves a set of 151 countries ranging from 1990 to 2018. The variable net foreign asset (ASSET) is employed to capture the external adjustment. Countries with better current account positions are associated with an (the) appreciation of their national currencies (Viera and MacDonald, 2012). Higher prices of exports in relation to prices of imports are positively associated with exchange rate, so the variable terms of trade (TOT) are introduced to capture

such effect (Viera and MacDonald, 2012). The government consumption (GOV) is introduced, in estimates, to capture changes in the demand composition, which is positively associated with exchange rate (Viera and MacDonald, 2012). Lastly, the wage-share of GDP (W) is considered to capture the effects of labor costs in tradable goods' prices. The argument is that higher (lower) labor costs make the exports more (less) expensive, then the outcome is a real exchange rate appreciation (depreciation).

Once estimated the equilibrium real exchange rate considering various fundamentals (PIBCAPITA, ASSET, TOT, GOV, and W), the last step in constructing the index of exchange rate misalignment was to calculate the difference between the real exchange rate (*LRER*) and the exchange rate adjusted by the different fundamentals provided by Models 1-7; Mis_1, Mis_2, Mis_3, Mis_4, Mis_5, Mis_6, and Mis_7. This is done following the procedure of Rodrik (2008). Negative (positive) values of exchange rate misalignments indicate that the exchange rate is undervalued (overvalued) in relation to the equilibrium real exchange rate.

2.3 Empirical Strategy and Database

The empirical strategy consists of estimating econometric regressions to explain the long-run growth employing databases in a panel setting for 151 countries over the period between 1995-2018. The dependent variable is the log-difference of real GDP *per capita* (PPP). This variable comes from the World Bank. The first basic growth equation is represented as follow:

$$y_{ti} = \alpha+\beta Y_{bi}+\beta_1 mis_{t-1,i}+ \beta_2 controls+f_t+f_i+ u_{it} \quad (2.3)$$

where f_t and f_i are a time fixed effect (5-year) and country fixed effects, Y_{bi} represents the convergence term (the logarithm of *per capita* GDP at beginning period), the measures of real exchange rate misalignments are used lagged to assure that causality runs from the right side of the equation to left side. A negative sign of β_1 means that exchange devaluations (overvaluations) are positively (negatively) associated with growth. Meanwhile, a positive

sign of β_1 means that exchange devaluations (overvaluations) are negatively (positively) associated with growth.

Other variables are controlled, such as years of education (human capital), executive constraints (institutions), saving rate, government consumption (fiscal discipline), openness degree (trade openness), and inflation (macroeconomic stability). The *rationale* in our empirical strategy is to estimate a baseline model (more parsimonious) with the lagged dependable variable (dynamic models), the convergence term, human capital, and one measure of real exchange rate misalignment (Model 1). Then, expanding the model by considering the variables saving rate (Model 2), government consumption (Model 3), openness degree (Model 4), and inflation (Model 5) in addition to the variables of the baseline model. At last, a final model is performed considering all independent variables (Model 6).

The estimates are performed using dynamic panel data models in a System of equations employing the levels and differences of independent variables as instruments – endogenous instruments (Blundell and Bond, 1998). This methodology estimates the parameters using the Generalized Method of Moments (GMM) and assures the control of individual unobserved characteristics and the elimination of the potential endogeneity of independent variables.

2.4 A summary of results: exchange rate misalignments and growth

The estimated coefficients for the variables *LRER* and the measures of exchange rate misalignments are summarized in **Table 2.1**, below. The output suggests that all coefficients are statistically significant (at 10% of critical values) and negative, meaning that a more depreciated (appreciated) real exchange rate boosts (harms) long-run growth.

Table 2.1 - Parameters estimated for *LRER* and Exchange Rate Misalignments

Model/ Variable	(1)	(2)	(3)	(4)	(5)	(6)	Avg.	Effect of devaluations (10%) on Growth 5-year (yearly)
LRER	-0.21	-0.16	-0.18	-0.23	-0.30	-0.15	-0.20	2% (0.14%)
Mis_1	-0.19	-0.14	-0.14	-0.24	-0.30	-0.14	-0.19	1.9% (0.13%)
Mis_2	-0.22	-0.15	-0.14	-0.26	-0.29	-0.14	-0.20	2% (0.14%)
Mis_3	-0.12	-0.09	-0.09	-0.16	-0.25	-0.15	-0.14	1.4% (0.06%)
Mis_4	-0.21	-0.14	-0.14	-0.25	-0.30	-0.14	-0.19	1.9% (0.13%)
Mis_5	-0.16	-0.13	-0.11	-0.24	-0.32	-0.21	-0.19	1.9% (0.13%)
Mis_6	-0.13	-0.12	-0.12	-0.22	-0.32	-0.27	-0.19	1.9% (0.13%)
Mis_7	-0.13	-0.12	-0.12	-0.21	-0.29	-0.26	-0.18	1.8% (0.12%)

Source: Author's estimates.

The parameters of the variables for exchange rate misalignments differ somewhat according to the fundamentals and growth equations' specification. The parameters are robust and tell the same story. Making the national currency weaker in relation to dollar (devaluations) fosters long-run growth, but an overvalued exchange rate hampers growth. On average, the parameters are: -0.20 (*LRER*), -0.19 (Mis_1), -0.20 (Mis_2), -0.14 (Mis_3), -0.19 (Mis_4), -0.19 (Mis_5), -0.19 (Mis_6), -0.18 (Mis_7). These results suggest that devaluations of exchange rate around 10% increase the growth of *per capita* income in 2%, 1.9%, 2%, 1.4%, 1.9%, 1.9%, 1.9%, 1.9% and 1.8% over a five-year period and 0.14%, 0.13%, 0.14%, 0.06%, 0.13%, 0.13%, 0.13% and 0.12% in terms of average annual growth rate, respectively.

A series of growth regressions were performed employing different exchange of rate measures, specifications, methods, controlling for other covariates and sets of countries. The results suggest that the exchange rate is not neutral for growth. Devaluations of exchange rate boost long-run growth as overvaluations hurt it. Furthermore, keeping the exchange rate at equilibrium values has not shown enough to explain growth, as Washington Consensus suggested. The effects of exchange rate are especially valid for developing countries, which is associated with the *per capita* income cut line used to define countries in development. It was also found suggestive evidence that

the exchange rate policy pursued by Asian countries helps to explain its better economic performance compared to Latin America and Africa. Lastly, there is no robust evidence that the effects of exchange rate on growth follow a non-linear pattern.

2.5 Conclusions

Taking into account the relevance of the exchange rate to explain the long-run growth in literature, this chapter proposed to assess, empirically, the effects from exchange rate movements for a set of one hundred and fifty-one countries over the period 1995-2018. Various fundamentals of exchange rate were considered in estimates to construct exchange rate measures employed in growth regressions. The most usual variables in literature were introduced into the regressions – the Balassa-Samuelson effect, net foreign assets, and terms of trade. The findings have pointed that the Balassa-Samuelson effect overlaps the remaining fundamentals. However, introducing labor costs in regressions indicated that *ceteris paribus* increasing (reducing) makes the goods more expensive (cheap). In other words, increasing the labor costs appreciate the real exchange rate, whilst cutting the labor costs depreciates the real exchange rate.

A set of regressions was performed using various exchange rate measures, different specifications and countries. The findings are robust in showing that devaluations (overvaluations) of exchange rate boost (hurt) growth. On average, devaluations of the exchange rate by 10% increase long-run growth roughly by 2% over a five-year period or 0.14% annually. Furthermore, additional regressions did not provide evidence that any kind of exchange rate misalignment is harmful to growth - as Washington Consensus claims, or that the effects of exchange rate on growth follow a non-linear pattern.

The exchange rate effects seem to be non-monotonic as they are associated with countries' income levels. However, this finding is associated with the *per capita* income cut line used to define a developing country, the measure of exchange rate misalignment, and empirical strategy to account for it. Growth regressions grouping countries in ranges of *per capita* income provide

evidence that devaluations of exchange rate do not explain the growth of countries with *per capita* income lower than US$ 3,346 and little evidence that it does for countries with *per capita* lower than US$ 6,000. Those results have changed widely in regressions for countries with *per capita* income lower than US$ 9,365 and US$ 24,725. Although the estimated parameters are lower than those of regressions employing the full sample of countries, the results indicate the exchange rate helps explain these countries' growth performance. Growth regressions with interacting dummies for countries with *per capita* income lower than US$ 3,346, US$ 6,000, US$ 9,634 provide poor evidence that the effects of exchange rate movements are stronger for these countries. However, it does not apply to countries with *per capita* lower than US$ 24,725, once all variables of the interacting dummy were statistically significant and negative, indicating that the effects of exchange rate movements are stronger for these countries.

The findings have delivered evidence that the pursuing of devalued exchange rate helps explain the more rapid growth of Asian economies compared with the poor growth of Latin America and Africa. Devaluing the exchange rate has contributed to the catching up of Asian countries while keeping the exchange rate overvalued has reduced the long-run growth of Latin America. However, even with devalued national currencies, African countries have grown poorly. This suggests that a devalued exchange rate acts more as a facilitating condition than a sufficient condition for growth (Eichengreen, 2008). A policy of exchange rate devaluations does not substitute good institutions, human capital, macroeconomic environment, and technological progress, but it potentializes these fundamentals' importance in the development process (Eichengreen, 2008). Moreover, estimates are suggestive that policies that reduce (increase) wage costs may increase (decrease) long-run growth by making national goods cheaper (more expensive).

3. Exchange Rate and Structural Change: A Study using Aggregated and Sectoral Data

Structural change toward manufacturing sectors is the central element in promoting the long-run growth within classical-kaldorian-structuralism economics. The classical authors of development economics, such as Rosenstein-Rodan, Nurkse, Singer, Lewis, Hirschman, and the Latin American structuralism, claim that industrialization is the central feature of a strategy in overcoming underdevelopment. In Kaldorian terms, the growth of productivity and economy is associated with the pace of industry growth. The faster is the manufacturing growth, the faster is the growth. Development is not an automatic process, as is suggested by Rostow's theory of take-off or a market-led process as claimed by the laissez-faire growth theories (Chang, 2002). The catching-up between nations results from deliberated industrialization policies, as the current richer countries have done in the past (Chang, 2002).

From a historical perspective, Asian and Latin American countries' recent experiences illustrate the importance of the state-led policy for industrializing and, hence, catching-up. The faster growth of Asian economies than Latin American economies may be explained by the different development models pursued. Asian economies adopted a nationalism model of development over the 1980s, while Latin American countries implemented a dependent model of development grounded on the Washington Consensus prescriptions (Kohli, 2012). Up until the 1980s, both Latin American countries as the Asians had similar economic features, and the differences pertain to the exchange rate and trade policies (Sachs, 1983). Asian economies adopted exchange rate devaluations to develop an export-led industry (outward-looking); meanwhile,

Latin America embraced import-substitution policies (inward-looking) (Sachs, 1983, Cavallo at al., 1990, Dollar, 1992). Despite the importance of trade and exchange rate policies, the South-Korean experience demonstrates the importance of a multidimensional strategy (e.g., credit, state investment, taxes, import protection, and entry restrictions) for a development strategy of industrialization and growth (Chang, 1993).

There is a significant body of empirical literature that documented the influence of exchange rate on long-run growth. The bulk of this literature has shown that exchange rate influences growth; devaluations foster growth, whereas overvaluations hurt it (Razin and Collins, 1997, Easterly, 2001, Acemoglu *et al*, 2003, Hausmann *et al*, 2005, Vieira and MacDonald, 2012, Glüzmann *et al*, 2012). This association is especially valid for developing countries (Gala, 2008, Rapetti *et al*, 2011). The influence on the productive structure is one of the mechanisms suggested by existing literature to explain why the exchange rate affects growth. As a relative price, the exchange rate changes the profitability of tradable and non-tradable sectors (Frenkel and Ros, 2006, Rodrik, 2008, Bhalla, 2012 and Ros, 2013). Devaluations of the exchange rate, by making the export goods cheaper, potentially benefit the sectors exposed to international competition (industry and primary sectors) to the detriment of services (Sachs, 1983).

Manufacturing is the sector with a vast ability to generate innovative activities, increasing returns to scale, and the backward/forward linkages (Tregenna, 2008, Szirmai, 2012). Enhancing the importance of modern sectors within a productive structure is the engine of long-run growth (Kaldor, 1966). Manufacturing sectors play a unique role in promoting the long-run growth, especially for the developing countries, as its productivity growth depends on the access to the technology of developed countries and the promotion of structural change towards modern sectors (Ocampo and Vos, 2008). The exchange rate rises as a tool of development for emerging countries. It makes access to new technologies developed by industrialized countries possible by generating the required funds to finance investment (via expanded profitability induced by the increase in exports). Therefore, an exchange rate policy orientated towards the development allows structural change and industrial diversification (Rodrik, 2008, Gabriel and Missio, 2018).

This article empirically tests the relationship between exchange rate and structural change using an aggregated and a sectorial database. The aggregated database covers different periods and countries. Multiple variables represent structural change: manufacturing, agriculture, and services as shares of GDP and employment, as well as the economic complexity index. By controlling other covariates, four measures of exchange are employed: a bilateral real exchange rate, two measures of exchange rate misalignment constructed by authors, and the index calculated by Couharde (2017). Estimates are performed using 5-years averaged database.

The sectoral regressions employ the database of World Input-Output Database provided by Timmer *et al* (2015). The sectoral performance is represented by the growth rate of employment and exchange rate misalignment is represented by the index calculated by Couharde (2017). Following the literature, estimates are afforded to account for the sectoral particularities by introducing variables denoting sectoral outward orientation, the costs associated with imports, financial constraints, and technological regime.

3.1 Why does the exchange rate matter for structural change?

A large body of empirical literature in economic field suggests that exchange rate influences growth (e.g., Cottani, 1990, Dollar, 1992, Razin and Collins, 1997, Vieira and MacDonald, 2012, Gala, 2008, Rodrik, 2008, Rapetti *et al*, 2011, among others). One of the influencing channels of the exchange rate is the firms' profitability. The exchange rate influences the sectoral profitability and promotes a structural change towards the sectors more benefited from exchange rate changes In this respect, the higher profitability, induced by the exchange rate policy, fosters production, employment, and investment (Frenkel and Ros, 2006). Exchange rate policies (by changing export competitiveness) expand or reduce tradable sectors' importance within the productive structure (Rodrik, 2008). Hence, as tradable sectors encompass the manufacturing sectors, the exchange rate policy may promote a structural change towards sectors with increasing returns to scale (Ros and Skott, 1998,

Frenkel and Ros, 2006, Rodrik, 2008). Thus, an influencing channel from the exchange rate to long-run growth is the profitability-development channel (Ros, 2013).

Frenkel and Ros (2006) point three transmission channels through which the exchange rate influences the employment creation. Firstly, the macroeconomic channel according which the exchange rate devaluations increase exports, demand, output, and employment, despite the contractionary effects caused by falls in the real wage. Secondly, devaluations of the exchange rate reduce labor costs, increasing the profit-rate, which encourages the use of more intensive labor. In contrast, overvaluations of exchange rate cut the profit-rate, which forces the firms to seek new manufacturing methods less intensive of labor. Lastly, the development channel links the exchange rate devaluations with industrialization through expanding its exports. This is because the exchange rate establishes the relative prices of tradable and non-tradable goods, acting as a tariff (subside) on imports (exports) (Frenkel and Ros, 2006).

In a similar fashion, Rodrik (2008) states that exchange rate devaluations boost the profitability of tradable sectors, increasing their importance in productive structure. Rodrik (2008) offers two explanations for the causal link between exchange rate devaluations, tradable sectors' profitability and growth. The first explanation is the idea that bad institutions of low-income countries act as a higher tax on tradable sectors, resulting in a misallocation of resources in terms of investment. Accordingly, by increasing profitability, exchange rate devaluations increase investment and efficiency (Rodrik, 2008). The second explanation is that one according which exchange rate devaluations act as a substitute for industrial policy to remedy the market failures of tradable sectors. Thus, taking the economic development as a structural change towards a productive structure more diversified and complex and assuming that market failures are more severe for these sectors, devaluations of exchange rate induce production of new products, boosting the complexity and long-run growth (Rodrik, 2008).

In contrast, the literature indicates that the influence of exchange rate on structural change within manufacturing sectors is not straightforward. There

are two opposing channels through which the exchange rate affects the sectoral profit-rate: the costs and the revenues of firms in a manner that its effect is associated with which channel prevails (Campa and Goldber, 2001, Nucci and Pozzolo, 1999, Galindo *et al*, 2007, Lanau, 2017).

On the cost side, devaluations reduce the labor costs (real wage) because firms raise their mark-ups to benefit from the favorable competitiveness regarding foreign goods (Blecker, 1989). Devaluations have distributive effects between workers and entrepreneurs. *Ceteris paribus*, exchange rate devaluations up the profit-share of GDP to the detriment of wage-share, potentially increasing growth (Blecker, 1989, Bhaduri and Marglin, 1990). However, devaluations can increase the production costs as it makes the imported inputs more expensive. For instance, a larger share of imported inputs, over total costs, strengthens the response of costs to exchange rate devaluations, potentially reducing growth (Nucci and Pozzolo, 1999, Campa and Goldber, 2001, Galindo *et al*, 2007, Lanau, 2017). The net effects of exchange rate on the firms' costs are associated with what effect prevails. If the first (second) effect prevails, *ceteris paribus*, a policy of devaluations increases (reduces) the importance of these sectors within the productive structure.

On the revenues side, larger the share of revenues that come from exports (domestic market) stronger (weaker) is the response of revenues to exchange rate devaluations (Nucci and Pozzolo, 1999). The effects of the exchange rate on firms' sales volume are associated with the degree that domestic demand or exports determine the firms' revenues. In a wage-led demand regime, the domestic demand prevails, and, then, exchange rate devaluations reduce the firms' revenues (Bhaduri and Marglin, 1990). However, in a profit-led regime of demand, the international demand (exports) prevails, and, then, exchange rate devaluations increase the firms' revenues (Bhaduri and Marglin, 1990). Therefore, the exchange rate effects on the firms' revenues are associated with the firms' demand composition.

Furthermore, the literature points out other influencing channels through which exchange rates affects the sectoral performance. An aspect brought up by Nucci and Pozzolo (1999) is the different effects of exchange rates on firms

according to the magnitude of mark-up. Firms with low mark-up suffer a financing constraint to invest as their retained profits are short, making them more dependent on financing sources. As a result, those firms' investment is more sensitive to the exchange rate policy as it can potentially boost its internal funds (Nucci and Pozzolo, 1999). Galindo *et al* (2007) introduced a new influencing channel into the picture, the balance sheet effect induced by liability dollarization; devaluations of exchange rate increase firms' financial burden with a significative share of debts in dollar. This creates real effects in firms as it raises the debt service leading to liquidity constraints (Galindo *et al*, 2007).

In sum, the literature indicates that the sectoral effects of the exchange rate are ambiguous. Changes in the exchange rate may hurt or boost sectoral performance depending on which effect prevails: the positive effect on revenues or the negative effect via costs. Likely, countries with non-developed manufacturing depend strongly on imports of basic inputs and physical capital to carry on a structural change towards manufacturing sectors. Thus, devaluations of the exchange rate can be an adverse effect on manufacturing performance. Therefore, exchange rate capacity to promote industrialization may be associated with the different cross-countries and sectoral characteristics.

3.2 Estimates for Aggregated Database

The empirical strategy consists of performing regressions to explain structural changes of 148 countries over 1991 and 2018. The basic estimating equation is:

$$y_{ti} = \alpha+\beta Y_{bi}+\beta_1 mis_{t,i}+ \beta_2 controls+f_t+f_i+u_{it} \quad (3.1)$$

where *i* and *t* denote country and time (5-year) index. Estimates were performed with time and country fixed effects, f_t and f_i, respectively. The dependent variable is the logarithm of manufacturing, services and agriculture in terms of share in GDP and employment. Estimates use four measures of exchange rates. The chapter employs data from World Bank for the real exchange rate (RER):

$$RER_{it} = \ln (PPP_{it}/XRAT_{it}) \quad (3.2)$$

The variables PPP_{it} and $XRAT_{it}$ are the conversion factor and nominal exchange rate in national currency units per U.S. dollar. Three further measures of exchange rate misalignments are used. The first one accounts for the discount of the Balassa-Samuelson effect from RER using the *per capita* GDP as fundamental of the exchange rate. The second measure of exchange rate misalignment is calculated employing the terms of trade (TOT) to capture the effects of exports' price in relation to imports' price, the net foreign asset (ASSET) to capture the external adjustment - as indicated by Viera and MacDonald (2012), and the wage-share of GDP (W) as a proxy for labor costs effects in prices of tradable goods. Finally, the exchange rate misalignment was calculated following Rodrik (2008), which produces the mis_1 (Balassa-Samuelson) and mis_2 (TOT, ASSET and W). The fourth measure of the exchange rate is the index of misalignment provided by Couharde *et al* (2017). This variable is calculated using co-integration techniques for econometric panels and controlling the Balassa-Samuelson effect, the net-foreign assets and the terms of trade as fundamentals. Couharde *et al* (2017) deliver an annual measure instead of a 5-years variable. This is important as Viera and MacDonald (2012) and Schröder (2013) showed that using annual measures of exchange rate misalignment may alter the estimates' results. Such variable is employed in structural change regressions averaged in 5-years.

When the exchange rate misalignments are greater than zero, the currency is higher than the purchasing power parity or than the equilibrium given by fundamentals (more appreciated). However, when it is lower than zero, the currency is lower than the purchasing power parity or than the equilibrium given by fundamentals (more depreciated). This applies to all measures of exchange rate misalignments. A negative sign of β1 in equation (3.9) means that exchange devaluations (overvaluations) are positively (negatively) associated with structural change. Whilst a positive sign of β1 produces the opposite results.

Other variables are controlled, such as terms of trade, government consumption, wage-share (labor costs of tradable sectors) and income

level (natural structural change induced by increases in income level). All controllable variables are employed in logarithm form. Two different specifications were performed. The difference is that one controls government consumption in addition to other variables, excluding wage-share (model 1), while the other specification controls wage-share, in addition to other variables, excluding government consumption (model 2). This is adopted to avoid collinearity between government consumption and wage-share once both variables are represented as GDP share. The estimates are performed using dynamic panel data models in a System of equations using the levels and differences of independent variables as instruments (Blundell and Bond, 1998). This methodology addresses the issue of endogeneity, as estimates are performed by *Generalized Method of Moments* (GMM) and assures the control of individual unobserved characteristics.

The output suggests that all coefficients estimated for exchange rate misalignment measures are statistically significant at 1% of critical values (except for specifications 6 and 7) and negative. Therefore, when the exchange rate is more depreciated (appreciated), it promotes structural change toward (non-) manufacturing sectors. The results are robust and go in the same direction (even though the parameters differ according to the fundamentals and the specification of the structural change equation). Making the national currency 10% more depreciated increase the manufacturing share in GDP share by 1.1% (model 1) and 0.6% (model 2) for *LRER*; by 1.3% (model 1) and 0.9% (model 2) for mis1; by 2.9% (model 1) and 0.4% (model 2) for mis_2; and by 1.8% for miscepii (model2) over a five-year period. Regressions also point out that share of the manufacturing in GDP is positively associated with income level (high-income countries have elevated manufacturing share in GDP) and terms of trade. Nevertheless, it does not provide robust evidence that government consumption influences it. Specifications 2 and 4 indicate that increases of 10% in wage-share reduce manufacturing share in GDP by 3% and 4%, respectively. Interestingly, the effects of the exchange rate are smaller when wage-share is controlled. Furthermore, specifications 5 and 6 indicate that exchange rate depreciation (cheaper exports) caused by reductions in wage-share benefits manufacturing.

The results of regressions using the manufacturing share in employment as a dependent variable indicate that the estimated parameters for exchange rate misalignment are statistically significant at 1% of critical values and negative. A devaluation of 10% in exchange rate increases the manufacturing share in employ by 1.2% for *LRER*; 1.1% for mis_1; and 2% for miscepii (all for model 1) Regressions do not provide evidence that manufacturing share in employment may be associated with income level, terms of trade, or government consumption. However, specifications 2 and 6 suggested that wage-share is negatively associated with workers' transfers from non-manufacturing activities to manufacturing activities. An increase of 10% in wage-share reduces in 7.6% and 5.7% of workers' share in manufacturing activities (respectively in columns 2 and 6).

The output of regressions using the agriculture share in GDP as a dependent variable provides evidence that exchange rate devaluations benefit agriculture. Despite the non-significance of mis_2 and miscepii, the results suggest that a devaluation of 10% increases agriculture share in GDP by 1.2% (model 1) and 1.15 (model 2) for *LRER*; 1.3% (model 1) and 1.9% (model 2) for mis1 over a 5-years period. Regressions do not deliver evidence that agriculture share in employment is associated with terms of trade, government consumption, or wage-share. Notwithstanding, results suggest that the agriculture share in GDP is negatively associated with income level (high-income countries have a smaller agriculture share in GDP).

The estimates using agriculture share in employment reveal little evidence that this variable is influenced by the exchange rate. Only the estimated parameter of *LRER* in model 1 is statistically significant at 1%. A devaluation of 10% increases the agriculture share in employment by 2%. Estimates also suggest that terms of trade, government consumption, or wage-share do not influence agriculture. In contrast, results indicate that increases in income are associated with reductions in agriculture share in employment.

Regarding the estimates for the share of services in GDP and in employment, no measure of exchange rate misalignment was statistically significant,

while only the income level is statistically significant and positive. That is, services have more importance within the productive structure of high-income countries (at least in terms of GDP share). Estimates do not provide much evidence that government consumption and wage-share influence both dependent variables. Moreover, results also suggest that improving terms of trade has expansionary effects on the share of services in GDP and employment.

3.3 Exchange Rate and Economic Complexity

A series of regressions were performed to test the association between economic complexity and the previous measures of exchange rate misalignment. The same empirical strategy of earlier estimates was adopted. The regressions provide evidence that a weak national currency is associated with greater economic complexity. The estimated parameters of *LRER*, mis_1 and mis_2 are statistically significant at 5% and around -0.0001. Interestingly, this parameter is statistically significant only in the specification that controls government spending instead of wage-share.

3.4 Exchange Rate, Income Level, Complexity and Structural Change

A series of regressions were run to test the link between the magnitude of the exchange rate's effects in structural change with income-level and economic complexity. The same empirical strategy of earlier estimates was adopted to explain the manufacturing activities in GDP. For that, an interacted variable between the measures of exchange rate misalignment and income *per capita*/ economic complexity was introduced in estimates. The results indicate that devaluating national currency expands the share of manufacturing sectors in GDP, but that such effect is stronger for countries with lower income. Exchange rate devaluations are more important in promoting structural change for low-income countries as far as it offsets its bad institutions, as Rodrik (2008) suggests. The estimates using the interaction between the measures of exchange rate misalignment and the economic complexity index indicate that the expansionary effects of exchange rate devaluations in GDP

manufacturing share are stronger for countries with more complex productive structure. Thus, it evidences that good institutions, great productive capability and more knowledge embedded in productive structure potentialize the expansionary effect of devaluations of the exchange rate in the manufacturing share of GDP. Therefore, regressions provide evidence that devaluations of the exchange rate should be adopted *pari passu* with other policies that improve economic complexity in order to potentialize its effects.

3.5 Exchange Rate and Manufacturing Sectors

This section estimates regressions to test the association between exchange rate and structural change at the sectoral level. The empirical strategy consists of performing regressions to explain the employment growth from 19 manufacturing sectors of 41 countries over 2000 and 2014. The basic estimating equation is:

$$emp_{tsi} = \alpha+\beta_1 mis_{t,i}+f_t+f_i+u_{it} \quad (3.3)$$

where *i*, *s*, and *t* denote country, sector, and the time index. Estimates were performed with time and country-sectors fixed effects, f_t and f_s, respectively. The dependent variable is the growth rate of manufacturing employment and comes from the world input-output database (WIOD) provided by Timmer *et al* (2015). The sectors are classified according to the International Standard Industrial Classification of All Economic Activities (ISIC) 4.0. The measure of exchange rate employed in regressions is the index of Couharde *et al* (2017).

Three further specifications are run considering the variable mist,i and its interaction with the sectoral share of inputs that comes from abroad (import), the share of sectoral income that comes from exports (export) and net exports (net export):

$$emp_{tsi} = \alpha+\beta_1 mis_{t,i} + \beta_2 (mis_{t,i} \times import_{tsi})+f_t+f_i+ u_{it} \quad (3.4)$$

$$emp_{tsi} = \alpha+ \beta_1 mis_{t,i} + \beta_2 (mis_{t,i} \times export_{tsi})+f_t+f_i+ u_{it} \quad (3.5)$$

$$emp_{tsi} = \alpha+ \beta_1 mis_{t,i} + \beta_2 (mis_{t,i} \times net\ export_{tsi})+ f_t+f_i+ u_{it} \quad (3.6)$$

The variables import, export and net export are calculated by the authors using the world input-output database (WIOD) 2016 release. Equations (3.4) and (3.5) aim at capturing the heterogeneous effect of exchange rate movements associated with the share of inputs that comes from abroad (import) and the share of sectoral income that comes from exports (export) as Nucci and Pozzolo (1999), Campa and Goldber (2001), Galindo *et al* (2007) and Lanau (2017) suggest. Equation (3.6) captures the heterogeneous effect of exchange rate movements associated with the difference between revenue (export) and cost (import) that represent the transmission channels from exchange rate movements into the profit-rate of firms.

The use of Arellano-Bond/GMM estimators is the usual practice in estimating the exchange rate effect on long-run growth to address the endogeneity issues in econometric panels (Vaz and Baer, 2014). The estimates are run using the method of Ordinary Least Square following Vaz and Baer (2014). The argument of the authors is that it is very unlike that a manufacturing sector determines the exchange rate mainly because each sector represents a small share of the productive structure. Plus, controlling the sectoral heterogeneity indicates that the exchange rate has different effects in distinct sectors, which eliminates the spurious correlation between the boom of commodities and growth of many countries (Vaz and Baer, 2014). Moreover, the use of index of misalignment of Couharde *et al* (2017) mitigates the effects of productivity growth, terms of trade, and net foreign assets on exchange rate and then avoids the possibility that the non-controlled variables produce vies in sectoral estimates.

The estimates deliver robust evidence that devaluating the exchange rate increases the growth rate of employment in manufacturing sectors - the estimated parameter of mis_{cepii} ranges from 0.12 to 0.17. Thus, a 1% more devalued exchange rate expands manufacturing employment by 0.15%, on average. The regressions did not provide evidence that the interacted variables are statistically significant.

3.6 The Sectoral Heterogeneous Effects of Exchange Rate

This section provides empirical evidence about the sectoral heterogeneous effects of exchange rate devaluation on employment growth within different

countries. Firstly, the empirical strategy consists of introducing a dummy for each country that interacted with the exchange rate to capture the cross-country heterogeneous effect of exchange rate on manufacturing employment. The aim is to estimate the effect of exchange rate movements within a country:

$$emp_{tsi} = \alpha+\beta_1 mis_{t,i}+\beta_2 (mis_{t,i} \times country)+f_t+f_i+ u_{it} \quad (3.7)$$

where country is a dummy to countries, the argument is that each country's "macro" characteristics – such as income distribution, national system of innovation, financial system, openness degree etc., produce particular effects of changes in exchange rate. Equation (3.7) estimates different slopes to each country and captures the cross-country particularities regarding the exchange rate.

Following Vaz and Baer (2014), a further specification is estimated considering the interaction between exchange rate and country dummies and the interaction between exchange rate and country-sector dummies:

$$emp_{tsi}=\alpha+\beta_1 mis_{t,i}+\beta_2 (mis_{t,i} \times country)+\beta_3 (mis_{t,i} \times country \times sector)+f_t+f_i+ u_{it} \quad (3.8)$$

where sector represents a dummy for 17 manufacturing sectors, the rationale is that movements of exchange rate affect the performance of manufacturing sectors in different ways, which is associated with the sectorial peculiarities (Vaz and Baer, 2014). Movements of exchange rate produce heterogeneous sectoral dynamics, and equation (3.8) captures it by estimating a slope to each sector within a country.

The robustness of estimates of equation (3.8) is assessed by performing a regression in accordance with Nucci and Pozzolo (1999), Campa and Goldberg (2001), Galindo *et al* (2007), and Lanau (2017), according to which the magnitude of exchange rate effect is associated with changes in costs and revenues produced by exchange rate movements:

$$emp_{tsi}=\alpha+\beta_1 mis_{t,i}+\beta_1 (mis_{t,i} x country)+\beta_2 (mis_{t,i} x country x sector x net\ export_{tsi})+f_t+f_i+u_{it} \quad (3.9)$$

Sectors with more imported inputs and revenues associated with exports tend to be more affected by exchange rate movements. Equation (3.9) captures

this argument by estimating a particular slope to each sector linked to its net export within a country. The empirical strategy is the same as earlier. The estimates that capture the cross-country and sectoral heterogeneous effects of exchange rate movements were performed by introducing dummies for the following developing countries Brazil, Indonesia, India, Korea, and Mexico.

Table 3.1 summarizes the regressions of equation (3.7) that estimates different slopes to each country to capture the cross-countries particularities regarding the movements of exchange rate.

Table 3.1 - Cross-country Heterogeneous Effects

Country	Effect of a 1% of devaluation in the exchange rate
Brazil	0.29%
Indonesia	0.54%
India	-0.16%
Korea	0.19%
Mexico	0.13%

Obs.: calculated by the author.

The results indicate that movements of exchange rate do not have uniform effects across countries. The estimated parameter of variable $mis_{t,i}$ is statistically significant at 1% in all estimates and around -0.11 and -0.13, indicating that the "common" cross-country effect of an exchange rate devaluation of 1% in the growth of manufacturing employment is around 0.12%. In turn, the parameter of the interacted variable $mis_{t,i}$ x country is statistically significant at 1% in all estimates (except for Mexico). The estimates suggest that devaluations of exchange rate have a positive effect on manufacturing employment of Brazil, Indonesia, Korea, and Mexico; an exchange rate devaluation of 1% increase the growth of manufacturing employment by 0.29%, 0.54%, 0.19% and 0.13%, respectively. In contrast, the estimates point that devaluations of the exchange rate are negatively associated with India's manufacturing employment; an exchange rate devaluation of 1% reduces the growth rate of manufacturing employment by 0.16%.

Regarding the estimates of equations (3.8) and (3.9), the estimated parameter of miscepii is around -0.12 in all estimates. The parameter of the variable miscepii interacted with the dummy for countries in estimates of equation (3.8) is -0.33 (Brazil), -1.43 (Indonesia), 0.70 (India), non-significant (Mexico), and 0.32 (Korea). Plus, the estimates of both equations confirmed the heterogeneous effects of the exchange rate across country-sectors once most of the sectoral slopes are statistically significant. Although the estimates of equation (3.8) provide evidence suggestive that devaluations increase the growth of manufacturing employment of the majority sectors, regressions also indicated that devaluations might hurt the growth employment of few sectors. This is the case of Brazil, Indonesia, Mexico, and Korea. Conversely, the regressions are contrasting for India as far as estimates indicate that devaluations of exchange rate reduce employment growth of the majority manufacturing sectors and promote it in few sectors.

Table 3.2 presents the effect of a devaluation of 1% on sectoral employment growth using the estimates of equation (3.8).

Table 3.2 - Sectoral Effect I of a devaluation of 1%

	Brazil	Indonesia	India	Mexico	Korea
10-12 Food products, beverages and tobacco products	0.22	0.57	0.24	-0.02	0.38
13-15 Textiles, wearing apparel and leather products	0.12	0.35	-0.04	0.15	0.37
16 Wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.36	0.82	-0.54	0.23	0.6
17 Paper and paper products	0.26	0.08	0.25	0.09	0.2
18 Printing and reproduction of recorded media	0.08	0.08	0.22	-0.03	0.44
19 Coke and refined petroleum products	1.06	0.48	1.26	-0.18	0.12
20 Chemicals and chemical products	0.9	0.24	-0.23	0.16	0.03
21 Basic pharmaceutical products and pharmaceutical preparations	0.61	0.24	-0.28	0.06	0.22

	Brazil	Indonesia	India	Mexico	Korea
22 Rubber and plastic products	0.24	-0.01	-1.28	-0.04	0.49
23 Other non-metallic mineral products	0.25	0.71	-0.29	-0.13	0.17
24 Basic metals	0.01	0.58	-0.07	0.13	0.15
25 Fabricated metal products, except machinery and equipment	0.39	0.58	-0.17	0.18	-0.04
26 Computer, electronic and optical products	0.14	0.25	-0.37	0.22	0.08
27 Electrical equipment	0.03	0.25	-0.41	0.42	0.16
28 Machinery and equipment	0.25	1.1	0.18	0.33	0.23
29 Motor vehicles, trailers and semi-trailers	0.41	0.94	0.82	0.08	0.13
30 Other transport equipment	0.3	0.94	0.82	0.33	0.11

A possible explanation for the contrasting result for India relies on the relatively small importance of exports in revenue of manufacturing sectors and the great share of imports in inputs. **Table 3.3** presents the average of the share of exports in revenue (x) and the share of imported inputs (m) in intermediate inputs:

Table 3.3 - Sectoral exports and imports (average of 2000-2014)

	Brazil		Indonesia		India		Mexico		Korea	
	x	*m*	*x*	*m*	*x*	*m*	*x*	*m*	*x*	*m*
10-12 Food products, beverages and tobacco products	0.19	0.05	0.17	0.09	0.06	0.04	0.06	0.15	0.05	0.12
13-15 Textiles, wearing apparel and leather products	0.13	0.11	0.53	0.29	0.24	0.08	0.41	0.32	0.4	0.16
16 Wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.28	0.08	0.43	0.1	0.08	0.09	0.08	0.13	0.02	0.22

	Brazil		Indonesia		India		Mexico		Korea	
	x	*m*	*x*	*m*	*x*	*m*	*x*	*m*	*x*	*m*
17 Paper and paper products	0.22	0.1	0.31	0.18	0.04	0.13	0.12	0.26	0.16	0.15
18 Printing and reproduction of recorded media	0.01	0.12	0.02	0.18	0.03	0.14	0.13	0.26	0.02	0.12
19 Coke and refined petroleum products	0.08	0.16	0.36	0.2	0.16	0.51	0.07	0.1	0.35	0.8
20 Chemicals and chemical products	0.12	0.16	0.35	0.29	0.18	0.19	0.15	0.23	0.28	0.21
21 Basic pharmaceutical products and pharmaceutical preparations	0.05	0.11	0.11	0.21	0.06	0.15	0.11	0.21	0.05	0.13
22 Rubber and plastic products	0.08	0.16	0.42	0.27	0.11	0.14	0.27	0.31	0.38	0.19
23 Other non-metallic mineral products	0.1	0.1	0.12	0.19	0.05	0.14	0.15	0.16	0.13	0.28
24 Basic metals	0.29	0.13	0.33	0.22	0.11	0.26	0.29	0.21	0.22	0.34
25 Fabricated metal products, except machinery and equipment	0.06	0.11	0.12	0.25	0.11	0.23	0.42	0.34	0.2	0.2
26 Computer, electronic and optical products	0.16	0.34	0.63	0.31	0.13	0.2	0.9	0.71	0.54	0.26
27 Electrical equipment	0.12	0.14	0.38	0.31	0.1	0.17	0.9	0.53	0.27	0.18
28 Machinery and equipment	0.19	0.16	0.32	0.43	0.11	0.22	0.77	0.45	0.29	0.18
29 Motor vehicles, trailers and semi-trailers	0.17	0.13	0.1	0.29	0.1	0.16	0.57	0.44	0.46	0.15
30 Other transport equipment	0.29	0.26	0.68	0.37	0.3	0.32	0.79	0.44	0.45	0.18
Average	0.15	0.14	0.32	0.25	0.12	0.19	0.36	0.31	0.25	0.23

Note: Elaborated by author using the database of world input-output database (WIOD) 2016.

Table 3.3 provides evidence suggestive that the manufacturing sectors of India are relatively more aimed for internal market and import more input from abroad than sectors of other countries, on average. In contrast, the

manufacturing sectors of the remaining countries are more outwarded oriented and have less cost associated with imports in general. Perhaps, this is a reason why devaluations of the exchange rate hurt the manufacturing sectors of India.

Regarding the estimates of equation (3.8), the parameter of miscepii interacted with the dummy for countries is -0.14 (Brazil), -0.53 (Indonesia), 0.24 (India), -0.10 (Mexico), and 0.09 (Korea). Table 3.4 summarizes the results by presenting the averaged total effect over 2000-2014 of a devaluation of 1% in the exchange rate on sectors using the estimates of equation (3.5).

Table 3.4 - Sectoral Effect II of a devaluation of 1%

	Brazil	Indonesia	India	Mexico	Korea
10-12 Food products, beverages and tobacco products	0.21	0.65	-0.01	-0.06	0.34
13-15 Textiles, wearing apparel and leather products	0.18	0.30	-0.05	0.05	0.26
16 Wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.42	0.66	-0.20	0.21	0.56
17 Paper and paper products	0.25	-0.12	-0.05	0.06	0.20
18 Printing and reproduction of recorded media	0.07	-0.13	-0.05	0.03	0.47
19 Coke and refined petroleum products	1.15	0.42	0.72	0.29	0.18
20 Chemicals and chemical products	0.10	0.25	-0.15	0.08	0.04
21 Basic pharmaceutical products and pharmaceutical preparations	0.61	0.11	-0.61	0.03	0.25
22 Rubber and plastic products	0.23	-0.05	-0.23	0.14	0.54
23 Other non-metallic mineral products	0.12	0.22	-0.11	0.03	0.15
24 Basic metals	0.10	0.19	-0.74	0.03	0.14

	Brazil	Indonesia	India	Mexico	Korea
25 Fabricated metal products, except machinery and equipment	0.14	0.15	-0.05	0.18	-0.01
26 Computer, electronic and optical products	0.25	0.66	-0.58	0.18	0.05
27 Electrical equipment	0.17	0.50	-0.40	0.36	0.10
28 Machinery and equipment	0.28	0.63	-0.19	-0.22	0.28
29 Motor vehicles, trailers and semi-trailers	0.25	0.48	0.07	0.01	0.14
30 Other transport equipment	0.24	0.73	-0.11	0.51	0.16

It should be noticed that the values of **Table 3.4** are similar to those of **Table 3.2** in many sectors and countries, suggesting some degree of robustness of results. Furthermore, there is positive association (at least graphically) between net export and the magnitude of the effect of devaluations of exchange rate on sectoral performance. This indicates that, on average, the effects of devaluations are stronger in sectors more outwarded oriented and with smaller share of imported inputs. Still, this does not apply to Korea because it is not possible to identify any graphical pattern in this case.

3.7 Conclusions

The current chapter has tested the association between exchange rate changes and structural change, using aggregated and sectorial databases. The empirical results have delivered evidence that the exchange rate matters for the structural composition within an economy. A weak currency is associated with a structural change toward tradable sectors, especially in the direction of manufacturing sectors in terms of the composition of GDP and employment. Interestingly, taking structural change as the manufacturing share in GDP, the results have indicated that the effect of exchange rate movements is stronger for low-income countries. Furthermore, the degree of economic complexity potentializes the effects of the exchange rate on the productive structure. On the one hand, those results indicate that devaluations of exchange rates act as the second-best mechanism to offset faulty institutions and foster structural change to modern sectors within developing countries, as Rodrik

(2008) indicated. On the other hand, evidence suggests that structural change toward modern sectors requires *pari passu* to adopt other policies linked with the promotion of complexity in the productive structure (i.e., knowledge, good institutions, etc.) to enlarge the earnings of a weak currency.

In addition, empirical evidence points out that an active exchange rate policy for development (by making national goods more competitive/more affordable) increases the economy's complexity, diversifies production and increases the knowledge embedded in productive structure. Conversely, regressions indicate that the effects of movements in the exchange rate are stronger for high-income countries.

The estimates using sectorial data confirmed the influence of changes in the exchange rate on the manufacturing sectors' performance. On average, devaluations of the exchange rate expand manufacturing employment. Though, this effect is associated with cross-countries and sector particularities. By estimating an individual slope for developing countries, the results suggest that devaluations have an expansionary effect on employment growth in Brazil, Indonesia, Korea, and Mexico. The same result applies to most manufacturing sectors of these countries. Conversely, exchange rate devaluations hurt the performance of most sectors of India. A possible explanation for this contrasting result relies upon the relative importance of exports in sectoral revenues and the share of costs associated with imports. India's manufacturing sectors are relatively less outwarded-oriented and import compounds a great share of costs.

Lastly, the sectoral estimates provided further evidence that the sectoral effects of changes in the exchange rate are associated with the regime of technological progress and financial constraint (i.e., low mark-up or great labor costs). A weak national currency boosts sectors' activity under a regime of high or slow pace of technological progress, while the effects of changes in the exchange rate are stronger for sectors more financially constrained, as Nucci and Pozzolo (1999) indicated. Still, sectors under a regime of slow pace of technological progress are more sensitive to changes in the exchange rate. The explanation for that relies on the stylized fact that those sectors are

more labor-intense and have great labor costs, indicating that the retained profit and the capacity to expand activities are short. Thus, devaluations of the exchange rate enhance the retained profit (by enlarging exports), which alleviates the social conflict between workers and capitalists, generating the internal funds to expand manufacturing activities.

4. Exchange Rate and Prices: An Extended Kaleckian Approach for Brazilian Manufacturing Sectors (2010-2019)

Many authors stressed the importance of the exchange rate in promoting economic growth. Pursuing a devalued exchange rate potentializes the fundamentals of long-run growth (education, saving/investment, good institutions, technological innovation etc.), but it does not substitute its importance (Eichengreen, 2008). Devaluations of the exchange rate act as a second-best mechanism to foster growth (Rodrik, 2008).

There exist many transmission channels that justify the positive effects of a weak national currency on growth. Exchange rate devaluations make the tradable goods cheaper in the international currency, which expands exports and generates more rapid growth (Rodrik, 2008). A weak national currency enhances profitability and enlarges internal funds to firms finance new investments, encouraging production and employment (Frenkel and Ros, 2006). Such an effect is reinforced by smaller real wages sparked by higher domestic prices. Exchange rate devaluations generate inflation because firms increase their markup to benefit from higher competitiveness in relation to foreign goods (Blecker, 1989) and because firms increase their prices to transfer the more significant costs associated with imported inputs. A regime of exchange rate for development drives the long-run growth by influencing the composition of national income towards saving/investment and exports, and the productive structure towards manufacturing and sectors more complex.

The other part of the story is that the exchange rate, as a relative price, affects domestic prices: devaluations make domestic prices more expensive

and international prices cheaper. However, strong devaluations may corrode the gains of competitiveness of national goods in international markets: by increasing the costs with imported inputs or due to social conflict between workers (real wage) and entrepreneurs (markup rate). Considering inflation as a real phenomenon resulted from social conflict, a certain inflationary acceleration within an economy under an exchange rate regime for development is inescapable. Devaluations of exchange rate have a distributive effect in favor of firms (markup rate) as real wages are eroded. However, if neither workers nor firms accept a smaller real income, the regime of exchange rate for development may engender an inflationary spiral, and the increasing inflation worsens the competitiveness of national goods, weakening the effects of exchange rate on growth.

The regime of exchange rate effectiveness for development, by promoting exports and growth, depends on the exchange rate pass-through into prices. The smaller the effect of the exchange rate on prices greater the gain of competitiveness; thus, the economy tends to grow more rapidly. Put differently, the exchange rate is crucial in determining the international competitiveness of national goods. However, the exchange rate's devaluations change the income distribution between workers and firms, strengthening the social conflict around real income. A possible consequence is an accelerating inflation as neither workers nor firms may not be willing to accommodate the costs of a weak national currency, which reduces the effects on growth. The inflationary effects of exchange rate devaluations should be the tinier as possible to make feasible and potentialize the export-led growth strategy. This story suggests that the effectiveness of the regime of exchange rate for development requires that workers accept smaller real wages, in the short-run, in exchange for possible higher real wages in the long-run; it is a tradeoff with distributive effects in the present and possible gains in future (Guzman *et al*, 2018).

It turns out that the advocates of regime of the exchange rate for the development focus on studying the association between exchange rate and long-run growth. Little attention is paid to understand the effects of exchange rate on prices *pari passu* the adoption a strategy for development based on a

weak national currency. This chapter aims to fill this gap in literature. The first goal is to understand the effect of devaluations of exchange rates on prices using the cost-push approach provided by Kalecki (1954). In particular, the objective is to comprehend the determinants of exchange rate pass-through on prices and the required conditions for a controlled/stable inflation within an economy under regime of exchange rate for development. An extended version of the Kaleckian approach is developed endogenizing the distributive effects of exchange rate devaluations and productive structure changes.

In other respects, literature points out that the adjustment of prices to exchange rate movements is incomplete and varies across countries, periods; moreover, it is associated with many macro and microeconomic aspects (Campa and Goldberg, 2002). Exchange rate pass-through is associated with industry characteristics such as product substitutability, the number of domestic and foreign firms, and market structure (Dornbusch, 1987). It is supposed that each industry has a specific dynamic of price adjustment after movements in the exchange rate (Dornbusch, 1987). The incomplete exchange rate pass-through also occurs because export firms absorb exchange rate devaluations by raising the prices (Krugman, 1987). Prices of exporters do not follow *pari passu* changes in exchange rate because firms increase markup by taking benefits from market power and pricing goods discriminated in accordance with characteristics of the end market (Krugman, 1987). Arestis and Milberg (1993), in turn, argue that firms pass, partially, increases in costs due to exchange rate devaluations because of the degree of competition within the industry. Hence, a lower markup rate absorbs the increased costs (Arestis and Milberg, 1993). The second goal of this article is to provide time-series evidence on exchange rate pass-through into the prices of 23 manufacturing sectors of the Brazilian economy over the period from 2010 until 2019 and explaining the results in light of these approaches.

4.1 A summary of the development of the theoretical model

Combining the Kaleckian and structuralist notions of inflation, the theoretical model developed in this chapter sought to argue that devaluations of the exchange rate strengthen the social conflict around real income by

creating misalignments of relative prices (i.e., national goods are cheaper in international markets to the detriment of higher prices in the national market). The smaller real wage induced by the exchange rate regime for development increases workers' claims for readjustments. As a result, the cost pressures due to readjustments of wages and the expanded costs caused by devaluations of exchange rate lead the firms to pass it on to prices. The bottom line is an inflationary process in which firms and workers defend the respective real income. Therefore, inflation results from the attempt of agents to neutralize the distributive effects of exchange rate devaluations. This is what Furtado (2009) called neutral inflation. **Figure 4.1** summarizes the main results of the theoretical model:

Figure 4.1- Equilibrium, devaluations of the exchange rate, and neutral inflation

Economy in "equilibrium"
Entrepreneurs and workers are satisfied with real income

The first round of inflation: Exchange rate regime for development is adopted
A devalued exchange rate alters the equilibrium; Costs with imported inputs increase and firms increase the markup rate; Inflationary pressures are absorbed by workers (lower real wage) – inflation constant over time to assure the effectiveness of the exchange rate regime for development

The second round of inflation: Workers are unsatisfied with lower real wage
Readjustment in salaries (past inflation is passed on) and economy initially returns to initial equilibrium (entrepreneurs and workers are satisfied with real income)

The third round of inflation: Exchange rate regime for development is less effective in promoting export as inflation accelerates and competitiveness is corroded
Firms pass on the higher labor costs on prices. New devaluations of the nominal exchange rate are required to keep the real exchange devalued. The equilibrium is altered again; inflation is strengthened, and the inflationary process returns to the first round

Devaluations of exchange rate alter the economy's equilibrium by transferring income from workers to firms (higher markup rate). Inflation is the mechanism through which such an income transfer occurs - assuming that the economy is initially under the equilibrium position (both entrepreneurs and workers are satisfied with income distribution). The adoption of an exchange rate regime for development pari-passu with stable inflation over time leads to the real wage squeeze ("first round of inflation"). It turns out, though, that workers will not accept a smaller real wage for a long time. Labor unions will claim readjustments in wages to restore the initial equilibrium in terms of the income distribution ("second round of inflation"). In turn, firms will pass on the higher labor costs on prices to defend the markup rate. As expected, the acceleration in the pace of changes in prices reduces the effectiveness of the exchange rate regime for development in promoting exports because inflation corrodes the international competitiveness of national goods. Therefore, a more substantial devaluation in the nominal exchange rate is required to keep the real exchange rate devalued, to the restored equilibrium be altered again ("third round of inflation"). As a result, inflation strengthens, as long the social classes attempt to restore the initial equilibrium (neutral inflation), pari-passu the adoption of exchange rate regime for development.

By endogenizing the markup rate to exchange rate, the theoretical model indicated that the necessary condition for stable inflation over time combined with an exchange rate regime for development is that wages reduce at the same pace that prices change due to exchange rate devaluations, everything else constant. However, by considering the effects of the exchange rate on productive structure, the results indicated that the structural change induced by a weak exchange rate might reinforce/mitigate the distributive effects of exchange rate devaluations. That is, industrialization reduces the dependence on imports. Hence, the exchange rate pass-through on prices falls, which opens the room to increase the markup rate or to mitigate the distributive effects on workers by allowing the real growth in wages with stable inflation over time.

The structuralist notion of neutral inflation was introduced into the extended Kaleckian model. The results indicated that the social conflict

between workers and entrepreneurs around real income potentializes the inflationary effects of exchange rate devaluations on prices. The greater the labor costs are, the stronger the inflation without distributive effects within an economy under an exchange rate regime for development. Numerical simulations evidenced that the exchange rate pass-through on prices is stronger (weaker) in economies in which the sectors under regime of slow (fast) pace of technological progress prevails. In this regard, the strengthening of social conflict because of a higher markup rate induced by exchange rate devaluations or increased salaries is especially determining of exchange rate pass-through in economies with a productive structure that is less advanced technologically. Besides, the adoption of industrial policies that increase the sensibility of structural change to exchange rate and the sensibility of imported inputs to industrial development have shown important in order to reduce the inflationary effects of a weak national currency, alleviating the social conflict in an economy under a regime of exchange rate oriented for developed.

4.2 Econometric Estimates: empirical strategy and database

The empirical strategy consists of estimating the effects of the exchange rate on industry prices of 23 sectors of CNAE 2.0 (Standard Industrial Classification 2.0) following two different procedures. Following Campa and Goldberg (2002) strategy:

$$p_{t,s} = \alpha + b_1 x_t + \beta_j e_{t-j} + \varepsilon_t \qquad (4.1)$$

where the subscripts *t* and *s* stand for time and sector, *p* represents price variation of industry, *e* the exchange rate and *x* a vector of controls, ε is the error term. Campa and Goldberg (2002) introduced lagged exchange rate values in the right side of equation (4.1) to capture the gradual adjustment of prices to exchange rate. The short-run relationship between exchange rate and industrial prices is given by the estimated coefficient β_0, whereas the long-run relationship is given by the sum of the coefficients on the contemporaneous exchange rate and its lagged values $\sum_{t=0}^{t} \beta_{t-j}$ (Campa and Goldberg, 2002).

Campa and Goldberg (2002) have estimated the equation (4.1) for 25 OECD countries using Ordinary Least Square (OLS) estimators controlling for energy costs and real GDP. The exchange rate is represented by the nominal exchange rate. Our estimates are performed using the Generalized Method of Moments (GMM) to address the endogeneity issues. Many non-controlled variables likely influence the exchange rate, leading to biased estimates. The GMM estimator solves this problem using lagged values of covariates as instruments, which are valid since the Hansen's (1982) test (test-J) does not reject the null hypothesis that instruments are exogenous. It is used a heteroskedasticity- and autocorrelation- consistent (HAC) estimators for the variance-covariance (Bartlett Kernel), being its lags chosen by the Newey-West method.

Two specifications of equation (4.1) were performed. As the available data is monthly, the first specification employs only contemporaneous and eleven lags of the exchange rate. No other explanatory variable was considered to minimize collinearity issues and to ensure that freedom degrees are scarce. It is important to notice that the degrees of freedom of test-J are the difference between moments and estimated parameters. Many instruments reduce the accuracy of test-J. Two sets of instruments are used with 4 and 5 degrees of freedom:

Instruments 1: constant, (lags: e_{t-12} until e_{t-27}) - 4 degrees of freedom

Instruments 2: constant, (lags: e_{t-12} until e_{t-28}) - 5 degrees of freedom

The second specification of equation (4.1) introduces the first lag of inflation to capture inertial inflation, sectoral production q to represent demand pressures, and oil price o as a measure of imported costs in addition to the exchange rate. Contemporaneous and lagged values of these variables were considered, using three lags of each variable as instruments as follow:

Instruments: constant, (p_{t-2}, p_{t-3}, p_{t-4}; e_{t-2}, e_{t-3}, e_{t-4}; q_{t-2}, q_{t-3}, q_{t-4}; o_{t-2}, o_{t-3}, o_{t-4}) - 5 degrees of freedom

This specification does not estimate the long-run pass-through of exchange rate into sectoral prices (over a year); it captures the short-run effect of

the exchange rate in industrial prices (at least until the preceding month), controlling for other variables.

The second strategy consists of estimating a Vector Autoregressive (VAR) to explore the results of Impulse Response Function (IRF), seeking to investigate how sectoral price reacts after a positive shock in the exchange rate (of one standard deviation). The long-run pass-through is calculated as the accumulated change of sectoral inflation after a shock of one standard deviation in the exchange rate (Cumulative Impulse Response Function – CIRF). Another result delivered by VAR estimates is the Forecast-Error Variance Decomposition (FEVD) that allows accounting what percentage of inflation's forecasted variance is due to exchange rate movements.

Following McCarthy (2007), Belaisch (2003), Nogueira *et al* (2013), and Correa (2017) a further estimate of pass-through is calculated in which the cumulative change of inflation (after a shock of one standard deviation in exchange rate) is standardized with respect to the cumulative change of the exchange rate after such shock. In this fashion, the pass-through is the inflation response due to an increase of 1% in the exchange rate (devaluation).

The VAR model is estimated using three endogenous variables (inflation, production, and exchange rate) and one exogenous variable (oil price). Small lag lengths generate a model misspecified, whereas long lag lengths produce inefficient estimates (Enders, 2003). The appropriate lag length was chosen by analyzing the usual information criterion of Akaike (AIC), Hannan-Quinn (HQIC), and Schwarz (SBIC). However, it should be noticed that the lag lengths suggested by the information criterion is not always enough to vanish residual correlation. In this case, further lags are necessary in order to the LM teste does not reject the null hypothesis of no residual correlation, which enlargers the variance of errors and the probability to include zero in the interval of confidence of IRF (non-statistically significance). Still, a VAR model is not interested in estimated parameters (due to the high collinearity), but in determining the interrelationship between variables – which has been made by means of IRF (Sims, 1980). Therefore, the guide to select the number of lags is the information criterion.

The VAR model does not allow to identify all parameters in its structural form because there is a feedback between the endogenous variables in the system (Enders, 2003). This leads to the necessity of imposing restrictions on the contemporaneous feedback effect. Sims (1980) has solved it, making the upper triangular part of the covariance matrix equals zero (Enders, 2003). This is known as Cholesky decomposition. It turns out that this solution imposes arbitrarily the contemporaneous causality (restrictions) between endogenous variables - which is not always in agreement with economic theory, leading to different results of IRF (Enders, 2003).

The strategy is to estimate the VAR model with two different orders of endogenous variables to circumvent the identification issue. Estimates assume that the exchange rate is the most exogenous variable (influenced contemporaneously by no variable). The first system adopts the following ordering [*e*; *q*; *p*] to capture the possible effect of the exchange rate in sectoral demand and, then, on sectoral inflation. There are two arguments for that. First, sectors with higher external demand are expected to be more benefited by exchange rate devaluations in a manner that such greater demand puts pressure on prices up. Second, another transmission channel from exchange rate into demand is the protection of the domestic market from international competition provided by exchange rate devaluation prices. The second system adopts the following ordering [*e*; *p*; *q*] to capture the possible demand-induced effect of the exchange rate on sectoral inflation and, then, on sectoral production. The *rationale* is that exchange rate devaluations increase prices, which leads firms to increase production. It should be noticed that the exchange rate influences contemporaneously inflation in both systems.

Data from 23 industrial sectors of Standard Industrial Classification 2.0 (CNAE 2.0) are used in this study. The data are monthly and covers the period between 2010:1 through 2019:12 (120 months). The Producer Price Index (PPI) comes from the Brazilian Institute of Geography and Economy (IBGE) and represents the sales prices received by firms free of taxes, tariffs, and freight. The pass-through is calculated using the nominal and the sectoral effective exchange rate to obtain robust results. Such variables are the price of Real (R$) in Dollar (US$) expressed in growth rate; hence, positive

(negative) values denote devaluations (overvaluations). The sectoral demand is represented by the industrial production that comes from Monthly Industrial Survey Production (PIM-PF) in growth rate. It should be noted that both PPI and sectoral demand variables are seasonally adjusted. The oil price is represented by the price of Brent Crude in US$, denoted in growth rate and came from the Federal Reserve of ST. Louis. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were performed and assured that all variables are stationary.

4.3 Estimates I: Generalized Method of Moments (GMM)

This section discusses the results of estimates by the Generalized Method of Moments. **Table 4.1** reports the long-run exchange pass-through estimated using GMM.

Table 4.1 - Sectoral Pass-Through (long-run: 12 months): GMM estimates

	Nominal exchange rate pass-through				Sectoral effective exchange rate			
	First Specification		Second Specification		First Specification		Second Specification	
Devaluation/ Sector	1%	1 s.d.a	1%	1 s.d.a	1%	1 s.d.b	1%	1 s.d.b
10	0.47	2.14	0.48	2.18	0.15	0.56	0.13	0.49
11			0.11	0.50	-0.12	-0.47	-0.13	-0.51
12	0.75	3.42	0.80	3.64	0.80	3.09	0.87	3.36
13	0.13	0.59	0.01	0.04			0.06	0.22
14	0.33	1.50	0.30	1.36	-0.38	-1.55	-0.12	-0.49
15	0.26	1.18	0.25	1.14	0.23	0.95	0.35	1.45
16	0.32	1.45	0.33	1.50	0.34	1.39	0.38	1.55
17	0.64	2.91	0.65	2.96	0.50	1.95	0.72	2.81
18	-0.17	-0.77	-0.03	-0.13				
19							0.16	0.75
20b	-0.22	-1.0	0.00	0.0				
20c	0.63	2.87	0.76	3.46				
21	0.10	0.45	0.46	2.09	-0.05	-0.16	-0.23	-0.75
22	0.7	0.31	0.07	0.31				

	Nominal exchange rate pass-through				Sectoral effective exchange rate			
	First Specification		Second Specification		First Specification		Second Specification	
Devaluation/ Sector	1%	1 s.d.a	1%	1 s.d.a	1%	1 s.d.b	1%	1 s.d.b
23	0.15	0.68	0.24	1.09	0.46	2.18	0.53	2.52
24							0.01	0.04
25	0.23	1.04	0.24	1.09	0.04	0.16	0.04	0.16
26	0.35	1.59	0.34	1.55				
27	-0.4	-0.18	-0.08	-0.36			-0.07	-0.26
28	0.8	0.36	0.06	0.27				
29	0.3	0.13	0.03	0.13	0.09	0.37	0.03	0.12
30	0.78	3.55	0.99	4.51	0.11	0.55	0.08	0.40
31	-0.1	-0.04	0.00	0.0	0.17	0.66	0.17	0.66
Extractive	0.20	0.91	0.21	0.95	0.27	1.17	0.53	2.30
PPI	0.18	0.82	0.17	0.77	0.34	1.47	0.41	1.78

Notes: (1) Tables 5.B 1, 5.B 2, 5.B 3 and 5. B4 (in appendix B of the thesis) present the full output of regressions; (2) specification 1 was run using 4 degrees of freedom of test-J (the instruments regressions contains a constant and 16 lags of exchange rate variable - from 12 until 27 periods); (3) specification 2 was run using 5 degrees of freedom of test-J (the instruments regressions contains a constant and 17 lags of exchange rate variable- from 12 until 28 periods); (4) the long-run pass-through is calculated as the sum of statistically significant parameters (at least at 10%); (5) the instruments has been valid for all regressions; (6) empty cells mean that no parameter was statistically significant; a1 standard deviation of the nominal exchange rate (4.56%); b1 standard deviation of the sectoral effective exchange rate (see Table 5. A3 in Appendix A of the thesis).

Using nominal exchange rate as independent variable, the results suggested that the pass-through from 1% of exchange rate devaluation into aggregated IPP is 18% and 17%, respectively for specifications 1 and 2. Only the following sectors have a pass-through greater than 50%: 12 (75% and 80%), 17 (64% and 65%), 20c (63% and 76%) and 30 (78% and 99%), in specifications 1 and 2 respectively. Whereas the sectors 10, 11, 13, 14, 15, 16, 21, 22, 23, 25, 26, 28, 29 and extractive industry have a pass-through lesser than 50%: (47% and 48%), (0% and 11%), (13% and 1%), (33% and 30%), (26% and 25%), (32% and 33%), (10% and 0%), (7% and 7%), (15% and 24%), (23% and 24%), (35% and 34%), (8% and 6%), (3% and 3%) and (20% and 21%), respectively in

specifications 1 and 2. The sectors 18, 20b, 27 and 31 have anomalous results once its exchange rate pass-through into prices was negative.

Using the sectoral effective exchange rate instead of the nominal exchange rate, results are different, but the incomplete pass-through remains. The pass-through from effective exchange rate to aggregated IPP is 27% and 53%, respectively, for specifications 1 and 2. The sectoral effective exchange rate's pass-through has shown more modest than that from nominal exchange rate. Only the following sectors have a pass-through greater than 50%: 12 (80% and 87%) and 17 (50% and 72%). Whilst the sectors 10, 13, 15, 16, 19, 23, 24, 25, 29, 30, 31 have a pass-through lesser than 50%: 10 (15% and 13%), 13 (0% and 6%), 15 (23% and 35%), 16 (34% and 38%), 19 (0% and 16%), 23 (46% and 53%), 25 (4% and 4%), 29 (9% and 3%), 30 (11% and 8%), 31 (17% and 17%) and extractive industry (27% and 53%), respectively, for specifications 1 and 2. The sectors 11, 14, 21, and 27 presented negative exchange rate pass-through.

Although the results suggest that no sector has a full pass-through of exchange rate devaluations (either nominal or real) around 1% into prices, the analysis changes when exchange rate devaluations are analyzed in terms of one standard deviation. A devaluation of 4.56% in the nominal exchange rate is fully passed to industries' prices and larger than 100% for various sectors. Only sectors 11, 13, 22, 28, 29, and extractive industries do not have a full pass-through. The same applies to a devaluation of 1 standard deviation in the sectoral effective exchange rate. In this case, only the prices of sectors 15, 25, 29, 30, and 31 increase less than 100% after an exchange rate devaluation of 1 standard deviation.

4.4 Estimates II: Vector Auto Regressive (VAR)

This section summarizes the results of estimates by Vector Auto Regressive. The estimates have been proved robust to the different orders of endogenous variables (different systems produced the same IRF and FEVD), and all eigenvalues lie inside the unit circle. The long-run pass-through after a shock of 1 standard deviation in the exchange rate and after an increase of 1% in the exchange rate (pass-through standardized) are summarized below.

Table 4.2 - Sectoral Pass-Through (long-run: 12 months): VAR's Results

	Nominal exchange rate				Sectoral effective exchange rate			
Sector	Pass-Through[a]	FEVD[b]	Month[c]	Pass-Through standardized[d]	Pass-Through[a]	FEVD[b]	Month[c]	Pass-Through standardized[d]
10	135%	21%	12	34%	64%	9%	2	17%
11		3%				16%		
12	213%	65%	12	61%	138%	34%	12	39%
13		5%				2%		
14	22%	2%	1	5%	26%	1%	1	5%
15	125%	42%	12	29%	109%	36%	12	20%
16	132%	38%	12	32%	86%	35%	12	17%
17	154%	36%	12	37%	136%	36%	12	41%
18		2%			-66%	12%	10	-17%
19	79%	9%	12	21%	-61%	15%	1	-13%
20b		2%				4%		
20c	182%	29%	12	49%	84%	14%	3	31%
21		2%				2%		
22	32%	6%	12	8%	67%	19%	12	25%
23	34%	7%	12	8%	71%	14%	12	12%
24	75%	16%	12	21%	39%	6%	1	7%
25	75%	42%	12	19%	93%	39%	12	21%
26	42%	6%	12	11%	50%	8%	12	7%
27		3%			33%	7%	12	7%
28	30%	12%	12	7%	31%	10%	12	6%
29	20%	12%	12	4%	20%	10%	12	3%
30	216%	68%	12	58%	224%	66%	12	41%
31	33%	13%	12	8%	39%	18%	12	10%
Extractive	72%	53%	12	19%	69%	44%	12	15%
PPI	83%	59%	12	22%	100%	59%	12	24%

Notes: a inflation's IRF (after a shock of 1 standard deviation in the exchange rate) represented by the value of the last month in which CRIF is statistically significant (when 0 is not within confidence interval); empty cells mean that no value of CRIF was statistically significant, b in the case that no value of CRIF is statistically significant, the value of FEVD represents the twelfth month; (1) Tables 5. C1- 5. C24 (in Appendix C of the thesis) present the full outputs of estimates; clast month in which CRIF is statistically significant; d standardized following the procedure of McCarthy (2007) to express the response of inflation to a shock of 1% in the exchange rate, which is calculated dividing the cumulative change of inflation after a shock in exchange rate by the cumulative change of exchange rate after such shock; (1) see Tables 5.C 1- 5.C 24 in Appendix C of the thesis to check the number of lags used and the stability conditions; (2) it is important to note that the CRIF of the exchange rate after a shock in exchange rate is not statistically significant for all 12 periods. The calculations of pass-through standardized are carried out using the values of cumulative change in the exchange rate of the value of the last month in which CRIF of inflation is statistically significant.

Estimates using the nominal exchange rate indicate that pass-through into aggregated IPP (after a shock of 1 standard deviation in exchange rate) is around 83%. The same applies for the sectors 14, 19, 22, 23, 24, 25, 26, 28, 29, 31 and extractive industry once the estimated pass-throughs are 22%, 79%, 32%, 34%, 75%, 75%, 42%, 30%, 20% and 33%, respectively. The FEVD for these sectors is lower than average (except for the sector 25): 14 (2%), 19 (9%), 22 (6%), 23 (7%), 24 (16%), 25 (42%), 26 (6%), 28 (12%), 29 (12%), 31 (13%). The pass-through is larger than 100% for the remaining sectors: 12 (232%), 15 (125%), 16 (132%), 17 (154%), 20c (182%) and 30 (216%). The respective FEVD are higher than average: 12 (65%), 15 (42%), 16 (38%), 17 (36%), 20c (29%) and 30 (68%), suggesting that exchange rate explain more the prices of these sectors.

The results using sectoral effective exchange rate indicate that pass-through into aggregated IPP (after a shock of 1 standard deviation in the exchange rate) is 100%. The pass-through is larger than 100% for the sectors: 12 (138%), 15 (109%), 17 (136%), and 30 (224%). The FEVD corroborated the importance of sectoral effective exchange rate in influencing prices of these sectors once it is greater than the average: 12 (34%), 15 (36%), 17 (36%), and 30 (66%). The same does not apply for the remaining sectors because its pass-through is lesser than 100%, and FEVD is lesser than the average in most sectors.

Estimates suggest that the pass-through standardized is incomplete (employing nominal or sectoral effective exchange rate). Using nominal exchange rate, the pass-through into aggregated IPP is 22%. While the sectoral pass-through is: 10 (34%), 12 (61%), 14 (5%), 15 (29%), 16 (32%), 17 (37%), 19 (21%), 20c (49%), 22 (8%), 23 (8%), 24 (21%), 25 (19%), 26 (11%), 28 (7%), 29 (4%), 30 (58%), 31 (8%) and extractive industry (19%). This result is confirmed by regressions employing sectoral effective exchange rate. The pass-through into aggregated IPP is 24%. Whilst the sectoral pass-through is: 10 (17%), 12 (39%), 14 (5%), 15 (20%), 16 (17%), 17 (41%), 18 (-17%), 19 (-13%), 20c (31%), 22 (25%), 23 (12%), 24 (7%), 25 (21%), 26 (7%), 27 (7%), 28 (6%), 29 (3%), 30 (41%), 31 (10%) and extractive industry (15%).

The estimates of exchange rate pass-through are robust. Both GMM as VAR estimates go in the same direction and suggest that prices increase less than

1% due to a 1% devaluation in the exchange rate - employing nominal or effective exchange rate. This is valid for aggregated and sectoral estimates. Therefore, Brazilian manufacturing sectors do not entirely pass devaluations of 1% in exchange rate into prices. Results are like those obtained by Correa (2017). Interestingly, all findings point out that the exchange rate pass-through estimated using nominal exchange rate is greater than that estimated using the effective exchange rate in both estimates.

4.5 Explaining the Pass-through for Brazilian Economy

The previous section demonstrated the prevalence of partial exchange rate pass-through for devaluations of 1% in the exchange rate on prices of Brazilian manufacturing sectors over the period between 2010 and 2019, and large variation of pass-through across the sectors. This section aims at exploring the previous findings in light of stylized sectoral facts (markup rate, outward orientation, competition among national and foreign firms, and costs with imported inputs) to offer possible explanations for those sectoral differences.

4.5.1 Market Power

According to the theoretical model developed earlier, the larger the markup rate stronger is the effects of devaluations of the exchange rate in prices, and the degree of imported inputs in costs intensifies such effect. The larger the share of imported inputs in costs, the higher is the increase in exchange rate pass-through due to an increase in markup rate, all else constant. The association between markup rate and pass-through is performed by a graphical analysis. This strategy is the only one possible because there is no monthly data that allows the use of econometric methods. Although this is a fragile analytical method, it delivers empirical evidence that suggests an association between the variables. The markup variable was constructed using the annual data from Annual Industry Survey (PIA) from IBGE over the period between 2010 and 2017. The methodology of computation is the same as Nucci and Pozzolo (2001).

The analysis confirmed the previous findings; the higher is market power, the higher is the capability of firms to pass on exchange rate devaluations into

prices. The correlogram also suggested a positive association between FEVD and markup rate, indicating that the exchange rate explains more the price changes of sectors in which markup is higher.

4.5.2 Outward Orientation

Krugman (1987) argues that the incomplete exchange rate pass-through occurs because export firms absorb exchange rate devaluations rising prices (Krugman, 1987). Exporters increase the price to take benefits from market power and discriminate prices in accordance with features of the end market (Krugman, 1987). Exchange rate devaluations are not passed fully into prices (in dollar), which increases the markup rate of these firms, *ceteris paribus*. Following this explanation, all else constant, it is expected that the effects of exchange rate devaluations are stronger for exporter firms. The graphs confirmed the results that the higher is the outward orientation, the higher is the pass-through. The correlogram suggests a positive association between FEVD and export coefficient, indicating that the exchange rate explains more the price changes of sectors more outward-oriented.

4.5.2 Outward Orientation

A result of the Kaleckian approach, developed earlier, is the association between the magnitude of exchange rate pass-through and the share of imported inputs in costs. The higher is the importance of imports in costs, stronger is the pass-through, *ceteris paribus*. The intuitive implication is that sectors that import more inputs are more affected by the exchange rate and pass more the devaluations into prices to defend markup rate, all else constant. However, Arestis and Milberg (1993) argue that the incomplete exchange rate pass-through occurs because firms absorb exchange rate devaluations reducing markup rate. This is due to the degree of competition among firms (Arestis and Milberg, 1993). Firms with a high share of imported inputs in costs nestled in an industry with fierce competition cannot pass devaluations of exchange rate into prices, absorbing it by means of a reduced markup rate.

The analysis suggests a negative association between pass-through estimated by VAR and the share of imported inputs in costs, even that it is weaker for

the pass-through of the nominal exchange rate. Such a negative association also applies to the FEVD and indicates that the exchange rate explains more the price changes of sectors with the least share of imported inputs in costs. Although this result is counter-intuitive, the argument is that the firms with a higher share of imported inputs in costs are nested within an industry more exposed to competition with foreign firms (as the data studied revealed). This way, those firms cannot pass on the higher cost due to devaluations of exchange rate into prices, which is absorbed in a reduced markup rate, as Arestis and Milberg (1993) have argued.

4.6 Conclusions

The empirical estimates of this chapter provided time-series evidence on the exchange rate pass-through into the prices of manufacturing sectors for the Brazilian economy over the period from 2010 until 2019. The results demonstrated the prevalence of partial pass-through for devaluations of 1% in the exchange rate and a large variation of pass-through across the sectors. A discussion about the empirical findings in light of stylized facts of Brazilian manufacturing sectors indicated three explanations to the differences in pass-through across the sectors. First, there is a positive association between markup rate and pass-through. Sectors with high market power are more capable of passing on the exchange rate devaluations. Second, empirical evidence indicates price-to-market discrimination of export firms because there exists a positive association between export coefficient and pass-through. Export firms absorb devaluations in the exchange rate, increasing their prices (markup rate). Third, results revealed that firms with a high share of imported inputs in costs, inserted in an industry with fierce competition with foreign firms, cannot devaluations of the exchange rate, absorbing it by means of a reduced markup rate.

5. Real Exchange Rate and Growth: Identifying Transmission Channels

Literature suggests that one transmission channel from RER towards economic growth occurs via its effects over the investment. The argument is that a competitive RER spurs the profit-rate of tradable sectors (Rodrik, 2008, Bahlla, 2012), redistributing the income from a class with a low propensity to save (workers) towards a class with greater propensity to save (firms) (Bahmani-Oskooe and Hajilee, 2010, Gluzmann *et al*., 2012, Guzman *et al*., 2018). The greater profit-rate, induced by the competitive RER, boosts the growth by inciting the firms to invest.

In other words, pursuing a competitive RER is a strategy to induce long-run growth because it increases capital accumulation (with reverberant effects over the technological progress and labor productivity). The cost of this strategy is to accept a lower consumption/real wage and more income inequality, at present, to boost the investment capacity of the economy and, possibly, the economic growth in the long-run.

The chapter's purpose is to investigate possible channels of influence from the RER into economic growth. First, the chapter studies whether, or not, pursuing a competitive RER is associated with changes in income distribution (personal and functional) and with changes in the allocation of GDP between consumption or saving/investment. Second, the chapter measures the influence of a competitive RER and labor costs over the net exports. Third, the chapter examines whether a competitive RER is associated with social capability and Total Factor Productivity. In the light of the literature's suggestion that the effects of a competitive RER are more important for developing countries, the article examines whether this assertion is valid for the study's variables of interest in the case of economies from Africa, Latin America, and Asia.

The study has used cross-country database panel data for 151 countries over the period between 1990 and 2017. The results suggest that a competitive RER is associated with a worse functional income distribution in favor of profit-share, and better personal income distribution. Moreover, the findings evidence that a competitive RER reduces consumption to the detriment of a greater investment/saving, whilst a competitive RER expands the net export directly by making the exports (imports) cheaper (more expansive) and indirectly by reducing the labor costs. The results also indicate that social capability and productivity growth are associated with other elements than labor, capital, and human capital, in this case, with the adoption of a competitive RER. At last, the regressions indicate that the effects of a competitive RER tend to be stronger in countries from Africa, Latin America, and Asia.

5.1 RER and Growth: a brief discussion about the transmission channels

One of the most important contributions to the existing literature, in terms of identifying the transmission channels by which the RER influences economic growth, is Rodrik's (2008) article. Rodrik's argument is the RER impacts the size of tradable sectors within the productive structure, mainly the manufacturing sectors, at detriment of the non-tradable sectors (services), which boosts the economic growth. The link between a competitive RER and this structural change is its expansionary effects over tradable sectors' profitability.

Rodrik (2008) provides two explanations to the influence of competitive RER on growth:

(1) The bad institutions explain, in parts, poor economic growth. Bad institutions damage the capital accumulation because of the social issues related to contractual incompleteness, hold-up problems, corruption, lack of property rights, and poor contract enforcement cut the ability of entrepreneurs to benefit from their investment (Rodrik, 2008). Moreover, Rodrik (2008) argues that such a problem imposes a higher tax on tradable modern sectors because of its more complexity. A competitive

RER can offset this problem by increasing the profitability, and then the investment, of tradable sectors. In this case, a competitive RER is the second-best mechanism to boost economic growth (Rodrik, 2008).

(2) The tradable sectors, mainly in developing countries, are more likely to suffer from market failures: learning and coordination externalities, credit market imperfections and wage premiums, leading to a suboptimal level of output and investment. In this case, pursuing a competitive RER is a substitute for industrial policy (Rodrik, 2008).

In Rodrik's (2008) view, a competitive RER boosts the economic growth via the induction of production, capital accumulation, and technological progress of tradable sectors. Such influence is more relevant in developing countries because it remedies its bad institutions.

Other authors emphasize the importance of pursuing a competitive RER to spur growth, especially in the context of countries with bad institutions. Acemoglu (2003) claims that a non-competitive RER is associated with the high volatility of economic growth, and that this is an indication of faulty institutions, as a non-competitive RER favors the maintaining of the elites in power. Johnson *et al* (2007) show that the poor countries can escape from the institutional weaknesses and the poverty inherited from the colonial history, as the Asian countries have been experiencing since the 1960s, by adopting the export-led strategy to promote the manufacturing exports. For that, avoiding RER overvaluations is essential (Johnson *et al*., 2007).

Gluzmann *et al* (2012), in the light of the abundant empirical evidence about the positive influence of a competitive RER on economic growth, investigated the channel transmission channels from the RER into the economic performance. The authors found a positive effect of RER devaluations over investment, saving, and employment. Gluzmann *et al* (2012) point out an additional channel to Rodrik's (2008) discussion. More specifically, RER devaluations reduce the real wages, transferring income from a class with a lower propensity to save to a class with a greater propensity to save (Gluzmann *et al*., 2012). In other words, RER devaluations increase the national saving by transferring income from workers to financially constrained

firms, which enhances the capacity of investment in the economy (Gluzmann *et al*., 2012).

Bahlla (2012) claims that an important channel from RER to economic growth is its capital accumulation effects. Bahlla (2012)'s argument is that the RER changes the profitability of investments by directly affecting the labor's cost. An overvalued RER discourages the investment due to its positive (negative) effect on the labor's cost (profitability) (Bahlla, 2012). In contrast, a competitive RER, by reducing (increasing) the labor's cost (profitability), spurs investment and, then, the economic growth (Bahlla, 2012). Furthermore, the author argues that a competitive RER compensates some poor countries' problems: real interest rates, bureaucratic costs, investment environment, and corruption.

However, it should be stressed that the "path towards prosperity and development" by the adoption of a competitive RER is not painless.

Bahmani-Oskooe and Hajilee (2010) argue that a competitive RER positively influences the firms' profits by redistributing income from workers to firms (if wages are not readjusted *pari passu* the inflationary acceleration induced by RER's devaluation), and negatively by making the imported inputs more expensive. Therefore, the effects of a competitive RER over the capital accumulation depend on which channel prevails (Bahmani-Oskooe and Hajilee, 2010).

Guzman *et al* (2018) point out that a competitive RER is associated with a trade-off between its effects on income distribution and economic performance. Pursuing a competitive RER means to accept a lower real wage and income, in the present, by promising a better standard of living in the future (Guzman *et al*., 2018). Put differently, a developing strategy based on a competitive RER means to lower the consumption (and real wage) to increase saving and, then, the economy's investment capacity, at present. If the investment, in fact, materializes, the society achieves more considerable economic growth with all the fruits of a faster pace of capital accumulation: technological progress and labor productivity. However, it turns out, that all

individual does not pay the price of a competitive RER in the present, and it is not clear whose life will be better, after the economic growth (Guzman *et al*, 2018).

Ribeiro *et al* (2020) studied the net influence of RER on economic growth considering two conflicting partial effects of a competitive RER: (i) its positive influence over technological progress, which fosters the economic growth, and (ii) its negative influence over the real wage and, then, positive influence over the income inequality, which damages the economic growth. The authors' findings for developing countries indicate that, in fact, RER devaluations increase the income inequality in terms of wage-share of GDP and the level of relative technological capabilities, influencing the economic growth indirectly via those channels. However, such an indirect effect of RER devaluation is negative (Ribeiro *et al*., 2020).

In a nutshell, the main argument of the discussed literature in this chapter is that the institutions are an important driver of long-run growth. Moreover, competitive RER can offset bad institutions' deleterious effects, inherited from history, of poor countries over its economic performance. The bad institutions act as lock-in point of poor economies within a specialized productive structure in few goods and low labor productivity, creating a trajectory of poor long-run growth. Pursuing a competitive RER is a manner to break the circular and cumulative process of poverty associated with bad institutions trap. A competitive RER contributes to change the growth path of society, encouraging capital accumulation and technological progress (to the detriment of worse income distribution and a lower (greater) consumption (saving) in the present), to, possibly, reach a more developed economy in the future.

5.2 Empirical Strategy and Database

The empirical strategy consists of estimating econometric regressions to explain the growth rate of wage-share of GDP w_{ti}, the income's Gini $gini_{ti}$, investment $i$ti, consumption c_{ti}, net exports nx_{ti}, social capabilities sc_{ti} and the TFP tfp_{ti} for 151 countries over the period between 1990 and 2017. All

dependent variables come from the Penn World Table 9.1, except for Gini's variable income that comes from Solt (2020). The estimated regression is:

$$y_{ti} = \alpha+\beta_1 Mis_{t-1,i}+ \beta_2 controls+f_t+f_i+ u_{it} \quad (5.1)$$

where the variable y_{ti} represents the dependent variables. The f_t and f_i are a time fixed effect (5-year) and country fixed effects. The variable M_{is} represents the measure of RER misalignment, employed lagged to avoid the simultaneity's problem.

The variable M_{is} is calculated by the authors following the procedure of Rodrik (2008). For this purpose, the variable real exchange rate *LRER* comes from the World Bank:

$$LRER_{it} = L(PPP_{it}/XRAT_{it}) \quad (5.2)$$

where *i* and *t* stand for the country and time (5-year) index, respectively. The variables PPPit and XRATit are the conversion factor and the bilateral nominal exchange rate (national currency units per U.S. dollar). In the case that *LRER* is greater than zero, the value of the national currency is more appreciated than the purchasing power parity. Nonetheless, if the *LRER* is lower than zero, the valor of the national currency is more depreciated than the purchasing power parity. The equilibrium value of *LRER* is calculated taking into account the Balassa Samuelson effect by estimating a regression of *LRER* on the *per capita* GDP (LPIBCAPITA):

$$LRER_{it}= \alpha + \beta LPIBCAPITA_{it} + f_t + u_{it} \quad (5.3)$$

The Hausman test indicated that the most appropriate estimating model of equation (5.3) is the Random Effect. The estimates of Rodrik (2008) indicated a Balassa Samuelson effect around 0.24, while our estimate provided a Balassa Samuelson effect around 0.19.

Following the procedure of Rodrik (2008), in which the variable M_{is} is obtained by subtracting the predicted values of equation (5.3) from the

indeed value of *LRER*, negative (positive) values of the variable M_{is} indicate that the *RER* is undervalued (overvalued) in relation to its equilibrium value. Therefore, a negative signal of β_1 in the equation (5.1) indicates that the *RER* devaluations (overvaluations) have an expansionary (contractionary) effect on the dependent variable. In contrast, a positive signal of β_1 indicates that the RER devaluations (overvaluations) have contractionary (expansionary) effects.

Regarding the control variables, it has opted to control only the inflation rate in the regressions performed to explain the wage-share of GDP and the income's Gini. The argument is that the inflation rate is associated with the income distribution as long it allows to redistribute the national income from workers to entrepreneurs and vice-versa.

The wage-share of GDP was introduced (in log-difference) as a controlling variable in addition to the inflation rate in the regressions performed to explain the remaining dependent variables. The argument is that the wage-share of GDP is a proxy for firms' mark-up of firms or for the labor costs (Bahduri and Marglin, 1989). Roughly, as greater is the growth rate of wage share of GDP/labor costs, lower tends to be the funds to finance the firms' investment and the national goods' international competitiveness. As greater is the labor costs, lower is the investment and the net exports. This is due to the increasing of consumption to the detriment of saving (or real wages in detriment of profits) and the loss of international competitiveness.

As the functional income distribution may be associated with the labor-saving technological progress: as greater is the wage-share in GDP, greater is the entrepreneurs' efforts to invest in new technologies. Therefore, the wage share in GDP is introduced, as a controlling variable, into the regressions performed to explain the social capability and TFP.

The regressions are estimated using the econometric methodology of Roodman (2009) in a dynamic panel model represented by a System of equations, in which both levels as differences of independent variables are used as instruments (Blundell and Bond, 1998).

5.3 Results of Empirical Estimates

Two further specifications are performed. The first specification tests if the RER effects are different for Asian, African, and Latin American countries. For this purpose, equation (5.1) is estimated for this restricted sample of countries. The second specification is a robustness check: equation (5.1) is estimated using the lagged value of *LRER* instead of M_{is}.

5.3.1 Income Distribution

The empirical results suggest that the estimated coefficient of the variable M_{is} is statistically significant, at least, at 10% and positive in the regressions for the full sample of countries as for the restricted sample of countries. The results indicate that devaluations of RER around 10% reduce the growth rate of wage-share in GDP by 0.40% over a five-year period. Simultaneously, the result also suggests that devaluations of RER around 10% reduce the growth rate of wage-share in GDP by 0.90% for the restricted sample of countries. The further regressions, employing the variable *LRER* instead of M_{is}, do not provide suggestive evidence that the variable *LRER* is statistically significant to explain the functional income distribution. Put differently, the estimates evidence that pursuing a competitive RER increase the mark-up rate, affecting the income distribution between workers and entrepreneurs. This effect tends to be stronger in economies from Africa, Asia, and Latin America.

The regressions performed to explain the income's Gini suggested that both measures of RER are statistically significant only in estimates that controlled the inflation rate. The results go in the opposite direction than those performed to explain the functional income distribution. Pursuing a competitive RER is associated with better personal income distribution. Devaluations of RER around 10% improve the personal income distribution by 0.4%.

5.3.2 Investment

The regressions are robust and tell the same story: pursuing a competitive RER spurs the investment. The result indicates that devaluations of RER

around 10% increase the investment by 1.6% over a five-year period for the complete sample of countries. The estimates also suggest that the RER effects over the economies of Africa, Asia, and Latin America are stronger: a 10% more devalued RER increases the investment by 2.2%. The additional regressions using *LRER* confirm the positive effects of RER devaluations on investment and its stronger effects in economies from Africa, Asia, and Latin America.

5.3.3 Consumption

The output of estimates performed to explain the consumption is robust and suggests that pursuing a competitive RER is associated with a smaller consumption as a share of GDP. From another perspective, as the saving is the share of national income that is not consumed, it suggests that devaluations of RER increase the saving. The regressions point out that a 10% more devalued RER reduces the consumption by 2.1% for the complete sample of countries over a five-year period. This effect is stronger for economies of Africa, Asia, and Latin America: a 10% devalued real exchange rate reduces consumption by 4.5%. The regressions using the variable *LRER* confirmed it.

5.3.4 Net Exports

The regressions performed to measure the RER effects on the net exports indicate that pursuing a competitive RER increases the net exports. Such a result is limited because it is valid only for the restricted sample of countries. The regressions performed using the restricted sample of countries indicate that the RER is statistically significant to explain the performance of net exports in all estimates. The output is robust and indicates that devaluations of RER around 10% increase the net exports by 3%. The regressions using the variable *LRER* confirm these results, suggesting that RER devaluations around 10% increase the net exports by 2.3%.

Despite the direct effect of RER on net exports, the regressions provide an additional result. Increases in labor costs are negatively associated with the net exports' performance. The labor costs parameter is statistically significant in many regressions and negative. The estimates suggest that this variable's

parameter is -0.36: an increase of 1% in wage-share reduces the growth rate of net exports by 0.36%. Moreover, the performance of net exports of economies from Africa, Asia, and Latin America is more sensitive to changes in labor costs: an increase of 1% in this variable reduces the net exports by 1.4%.

5.3.5 Social Capability and Total Factor Productivity

The results of regressions performed to measure the RER effect on the social capability, represented by the TFP (USA=100) are robust. All estimated parameters are statistically significant at 1%. Pursuing a competitive RER reduces the gap between the USA economy's social capability and the domestic economy. The estimates using the variable M_{is} suggest that RER devaluations of 10% reduce the gap between the USA economy's social capability and the domestic economy by 6% over a five-year period. The regressions employing the variable *LRER* confirm it. The regressions using the restricted sample of countries do not provide much evidence that the RER influences its TFP's performance.

The estimates also provide empirical evidence that pursuing competitive RER influences the TFP positively. Specifically, the results indicate that the estimated parameter of M_{is} and *LRER* is statistically significant only in the regressions performed using the complete sample of countries. The parameter of M_{is} is statistically significant at 10% and around -0.10: RER devaluations of 10% increase, roughly, the productivity growth by 1% over a five-year period. The parameter of *LRER* is statistically significant at 1% and equals -0.14: RER devaluations of 10% increase the productivity growth by roughly 1.4%.

5.4 Conclusions

The goal of this chapter was to investigate the channels of influence of RER on growth. For this purpose, a series of regressions were performed to measure how pursuing a competitive RER impacts the income distribution (personal and functional), the allocation of GDP between consumption or saving/investment and the behavior of net exports, social capability, and Total Factor Productivity. The article also provides a series of regressions to test

whether the effects of pursuing a competitive RER are stronger for economies from Africa, Latin America, and Asia. The chapter's results provide evidence in support of the transmission channel from RER onto growth, pointed by literature. The investigation indicates that pursuing a competitive RER favors the saving/investment to the detriment of consumption and wage share of GDP, corroborating the previous findings. The results confirm that pursuing a competitive RER increases the profit-rate (to the detriment of real wage), transferring income from workers to firms, which spurs the investment, as Gluzmann *et al* (2012), Bahlla (2012), Bahmani-Oskooe and Hajile (2010) and Guzman at al. (2018) argue. The findings also indicate that pursuing a competitive RER exerts a positive impact on net exports. This effect occurs directly by making the exports (imports) cheaper (more expensive) and indirectly by reducing the labor costs.

It is worth highlighting that the effect of pursuing a competitive RER over consumption, saving/investment, and net exports (the direct as the indirect effect) is stronger for economies from Africa, Latin America, and Asia. A possible explanation for this result, in addition to the Rodrik's (2008) argument, is that those countries have a rudimentary financial system. In this way, the expansionary effects of a competitive RER over the profitability are more important to generate the required funds to finance new investments. Alternative explanations derive from the more financial constraint due to (i) the bad institutions that impose a higher tax, which discourages new investments and makes the national goods less competitive (Rodrik, 2008); (ii) the labor is a great share of costs in a manner that the effects of pursuing a competitive RER over profitability and net exports, by reducing the real wage, are stronger.

Finally, the study provides evidence that social capability and Total Factor Productivity are associated with other elements than labor, capital, and human capital. Specifically, pursuing a competitive RER expands the social capabilities and the Total Factor Productivity of the economies, on average. However, the analysis revealed that the RER does not exert an extraordinary influence on these variables in countries from Africa, Latin America, and Asia. A possible explanation is that the influence of RER over the social capabilities

and the Total Factor Productivity is associated with aspects of the supply-side. Societies with better institutions, a good entrepreneur environment, a developed national system of innovation, human capital, etc., are more inclined to absorb the benefits of pursuing a competitive RER, transforming it into the development of social capabilities and technological progress.

This chapter's findings have important policy implications: a competitive RER may foster important long-run growth drivers, such as capital accumulation, net exports, social capabilities, and technological progress. A development strategy of pursuing a competitive RER may spur the long-run growth – especially in developing countries locked within a bad institutions trap. However, it is worth stressing that such strategy imposes a considerable cost in terms of lower real wages and consumption, in the present, with the promise of achieving a more developed society in the future, even that it is not clear if the economic development's fruits will be shared between all individuals, as Guzman *et al* (2018) argue.

In contrast, the study delivers evidence that pursuing a competitive RER is associated with better personal income distribution. Future works should provide more evidence on this topic to investigate the possible transmission channels through which a competitive RER may contribute to a more equalitarian society.

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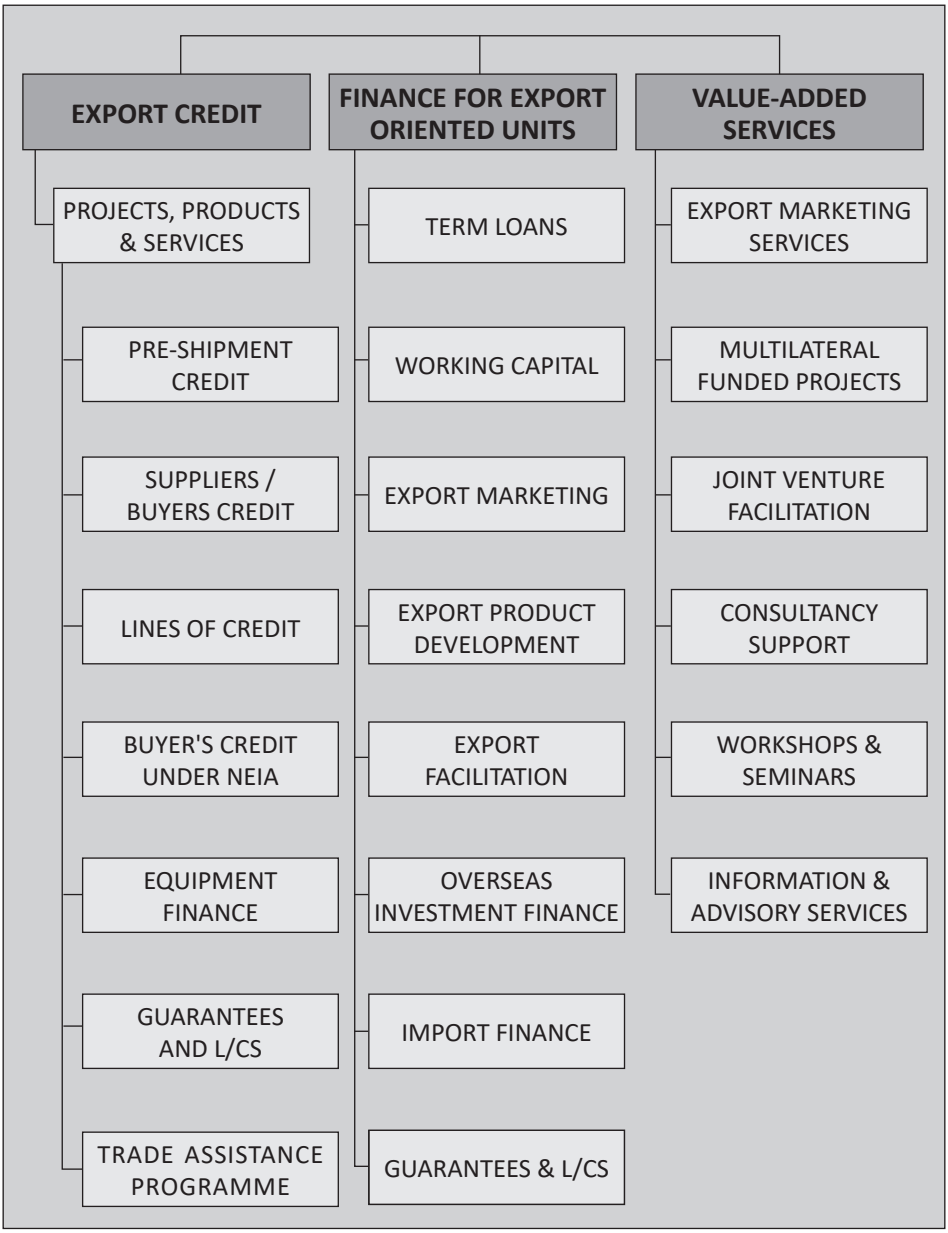

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