The economies of East Asia, notably China, South Korea and Vietnam, have undergone significant industrial transformations over the last several decades. The rapid transition from largely low-productivity, agriculture-based to high-productivity, modern economies was built on a foundation of manufactured exports to the developed world. In contrast, the economies of Sub-Saharan Africa are still largely resource-based, with little manufacturing export activity.

This thesis examines the potential role of exchange rate policy in promoting the manufactured export sector in Africa. Both empirical and theoretical work suggests undervalued domestic currencies played a key role in promoting the growth of manufactured exports in East Asia. The thesis begins by looking at why manufactured exports are important for economic development, looking at both empirical findings and the theoretical underpinnings. The role of exchange rates in the industrialization process is examined, with presentation of both empirical work and an in-depth look at two theoretical models. These findings are then used to assess the potential for a successful strategy of currency undervaluation in Africa. The main finding of the thesis is that such a strategy seems difficult both in terms of economic fundamentals and political reality and could present significant issues going forward.
Going Chinese:
Is Exchange Rate Undervaluation a Relevant Policy for Boosting Africa’s Manufactured Export Sector?

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1. Introduction

Manufacturing exports have been a key driver of the rapid East Asian economic transformation. Countries, notably China, South Korea, Vietnam among others, moved from largely agrarian, low-productivity economies to industrial, high-productivity global players. This route from the farms to the factories was paved by the global trade in modern sector products.

While East Asia grew at a stark pace, Sub-Saharan Africa’s (henceforth Africa) growth performance and broader economic development have been largely disappointing. In the 1960’s, the average African income per capita was at the level of its East Asian neighbors, if not slightly higher. Today, average incomes are manifold higher in East Asia. Indeed, African incomes have largely stagnated over the last five decades, though with some promising signs over the last decade in many countries.\(^1\)

![Figure 1: Evolution of Incomes: East Asia vs. Sub-Saharan Africa](source: World Bank World Databank 2012)

There are a variety of different explanations for the miraculous growth of East Asia, depending on who one asks. High savings rates, relatively well-managed industrial policy, technology transfer from the West, investment in infrastructure and education were all part of the success. This thesis will not seek to explain the Asian miracle, but

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\(^1\) Radelet (2010)
rather focus on the role of exchange rate policy in the transformation and its implications for Africa. Rodrik (2009) and others argue that undervalued currencies have been a crucial factor in spurring the boom in manufactured exports in many high-growth East Asian countries. Could this be part of the answer for Africa?

This paper is organized as follows. Chapter two examines the economic literature on manufacturing and its role in economic development. It explores the current situation in the sector across Africa and highlights the thinking on what is constraining this important segment of the economy. The next chapter delves into the role of exchange rates in the development process, examining the theory and empirical evidence for the effects of exchange rates in promoting the manufactured export sector and broader economic growth. This section introduces the various methods for estimating exchange rate misalignment and discusses key issues related to the measurement.

Chapters four and five introduce two theoretical models which illustrate the mechanisms behind the currency undervaluation and growth relationship. The first model, developed by Rodrik (2009), builds on the assumption that the export sector is affected more acutely by institutional weaknesses than the domestic production sector and an undervalued currency acts as a second-best solution in addressing these weaknesses. The second model, developed by Korinek and Severn (2010), is more comprehensive, looking at the welfare effects of undervaluation through foreign reserve accumulation and the importance of learning-by-investing effects in the export sector.

In chapter six, the thesis turns from the theoretical to the subject at hand: could exchange rate undervaluation be a sensible policy option for African economies? This section looks briefly at the history of exchange rate policy in Africa and presents estimates of the misalignment of currencies at present. Policy options are explored and their impact on spurring manufactured exports is analyzed. Chapter seven concludes.
2. Manufactured exports: Why they matter and how Africa is progressing

2.1. Manufactured exports and development

To understand why manufactured exports are often so critical to robust and sustainable economic growth, one must first break down this compound into its two elements: manufacturing and exports. One of the first seminal theories of development economics, authored by Nobel-prize winning economist Arthur Lewis, was the dual-sector model. In the model, economic development is explained by the structural shift of moving surplus labor from the low-productivity agricultural sector into the higher productivity modern sector. Unlike the largely subsistence agriculture sector in Lewis’ model, the modern sector can reinvest profits productively, spurring economic growth.\(^2\) Another crucial part is the even older Engel’s Law. Ernst Engels, a 19\(^{th}\) century German statistician, observed that as income rises, the share of expenditure dedicated to food decreases. In other words, the income elasticity of demand for food is less than one.\(^3\) An economy which relies on agricultural output will quickly hit a ceiling as the demand for food is relatively finite. Prebisch and Singer formalized this idea into formal economic theory. The Prebisch-Singer thesis extends Engel’s argument to include all primary products (not just agriculture), and contends that the income elasticity for manufactured goods will be higher than for primary commodities.\(^4\)

The same is true on a global level. Primary commodity-focused economies can supply the global market, increasing their income, but what is true on the country level is true on the global level: demand for primary goods is relatively inelastic, and eventually increasing supply will push down prices and subsequently incomes. Manufactured goods, especially on the global market, have much higher income elasticities of demand, meaning the room for income generation is vastly greater. Manufactured products are significantly more diverse and the output can expand both on the intensive (increasing volumes through productivity gains) and extensive (increasing product varieties through investment in innovation) margins contributing significantly more value addition than

\(^2\) Lewis (1954)  
\(^3\) Zimmerman (1932)  
primary products. Further, manufacturing tends to be less vulnerable to global business cycles than natural resources which can exhibit high price volatility.\(^5\)

Important political economy arguments must also be considered. The manufacturing sector creates significantly more employment than natural resource extraction and at better wages than agriculture.\(^6\) Increasing returns to skills in manufacturing promote the demand for education, a key factor for long-term growth. Unlike with natural resources, manufacturing does not create enormous rents and therefore the government must rely on taxation of the firms, and provide public services in return. In essence, manufacturing can create a virtuous cycle of improvement in the political institutions and the public incentive to keep these institutions clean.

Clearly the internal structure of an economy matters to development, but what about the role of exporting? Hausmann, Hwang and Rodrik (2007) compare what a country exports to its economic performance. The authors create an index (EXPY) for each country’s export basket of goods which ranks goods according to the income levels of the countries that export them. In other words, primarily developed countries goods, which generally tend to be higher-value added products, are at the top of the spectrum, while goods exported by low income countries, primarily low-value added, are at the bottom. They find that a 10% increase in a country’s EXPY index correlates with an increase in GDP growth of 0.5%.\(^7\) In other words, exporting higher value added goods is associated with stronger economic growth. Further, the authors argue that this is not due to endogenous factors, rather “EXPY exerts an independent force on economic growth and that it is not a proxy for the factor or institutional endowments of a country.”\(^8\) Paraphrasing the title of the article, what you export matters.

Indeed, expanding into global markets can induce stronger firm performance through a number of channels. First, the global market is an order of magnitude larger than any domestic market, even in the case of China, the world’s second largest economy. International markets present a significant increase in the potential customer base. Looking at the performance of Chinese manufacturing firms between 1995-2000, Park

\(^5\) Taylor (2009), p.3  
\(^6\) Mijiyawa (2012)  
\(^7\) Hausmann, Hwang and Rodrik (2007), p.18  
\(^8\) Hausmann, Hwang and Rodrik (2007), p.20
et al. (2010) find that a 10% increase in a firm’s exports correlates on average with an increase of 6-7% in the firm’s sales. Similarly, Van Biesebrock (2006) examines micro-level data on manufacturing firms in Africa and finds that past export activity raises current output by 25%. Indeed, this argument is of particular interest for African countries with often very small markets given the low average per capita incomes on the continent.

Secondly, the empirical evidence is quite consistent in showing that export-oriented firms are more efficient than domestic-oriented firms. For example, Aw et al. (2000) find that Taiwanese and South Korean exporters had total factor productivity levels 10% to 30% higher (depending on which sector) than non-exporting firms in the same industry. Equally importantly, these productivity differences trickle down into increasing incomes: Aw and Batra (1995) find that Taiwanese export-oriented firms paid 14% to 30% higher wages than comparable domestically-oriented counterparts.

Though economists agree exporting firms are more productive, the literature is not of one mind on what drives these productivity differences. One line of reasoning is that the most efficient firms enter the global markets precisely because they are the most productive: there is a self-selection process which drives the apparent productivity differences. This seems to be especially true for developed countries, as studies on exporting and firm performance from the US, Canada and several European countries show. However, there is more conclusive evidence that developing countries, which are often far away from the global technological frontier, benefit directly from entering exports. In other words, there is a direct causal relationship between exports and productivity gains.

This increased productivity can be driven by two mechanisms. First, as mentioned earlier, access to new markets can increase firm sales and production. Increasing production can allow firms to exploit technical advantages stemming from economies of scale. Van Biesebrock estimates that 50% of the productivity premium of African

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9 Van Biesebroeck (2005), p. 386
10 Söderbom and Teal (2001), Aw et al. (2000), Kraay (1999), Clerides et al. (1998) and Bernard and Jensen (1995) among others
11 Aw et al. (2000), p.11
12 Aw and Batra (2000)
exporters (vs. non-exporters) can be explained by this effect. Indeed, his findings show that the productivity gap increases when the firms begin exporting, showing that there is more than simply self-selection at work.

The second mechanism is the so-called learning-by-exporting effect. An extension of Kenneth Arrow’s learning-by-doing theory, firms increase productivity from interacting with international buyers and from the more competitive nature of operating in the global marketplace. International buyers demand higher quality, low-cost goods and often share proprietary information or technology with the suppliers. Firms can also pick up on global trends in demand and new production tools. Empirical evidence is mixed in support of this argument, though Martins and Yang (2009) argue disaggregating the data paints a more conclusive picture. Reviewing 30 recent empirical studies on learning from exporting, the authors find that there is strong evidence for learning from exporting for developing country firms, while not for firms from developed countries. This is in line with economic theory: developing country firms tend to be less technically sophisticated and further from the global technology frontier. Hence, these firms have more to gain from interacting internationally, especially with developed country buyers (an “advantage of backwardness”). Bigsten et al. (2004) confirm this finding using firm-level panel data from four African countries: exporters increase productivity as a direct result of exporting. Mengistae and Patillo (2004) show a similar finding: firms exporting outside of Africa tend to be more productive than those exporting within Africa. This is consistent with the learning-by-exporting theory, as the potentials for technological diffusion is greater with more developed countries.

Finally, a broader political economy argument must be revisited. Manufactured exports have markedly different effects on the political structure and incentives for politicians than natural resource exports. Manufacturing tends to create significantly more employment than resource extraction, which helps to broaden the middle class. The middle class, with more incentive to participate in the political system, demand more

15 Van Biesebroeck (2005), p. 392
16 Arrow (1962)
17 World Bank (1993)
18 Martins and Yang (2009)
19 Bigsten et al. (2004), p. 133
20 Mengistae and Patillo (2004), p.1
accountable government (partly as they are now tax payers) which helps to create a virtuous cycle of improved government. Revenues from the extraction and export of natural resources, on the other hand, tend not to create significant employment opportunities for local labor. For example, the Nigerian oil sector, which accounts for close to 40% of the country’s GDP, only contributes 1% of total modern sector employment. Instead of wages to workers, the revenues accrued are rents to the government. These rents often create a damaging political environment, with leaders focused on capturing these rents, rather than providing public services. Given that these rents reduce the incentive for the government to tax its citizens, ordinary people have less incentive to try to hold the government to account, creating this time a vicious circle, often referred to as the natural resource curse.

Johnson, Ostrey and Subramanian (2007) – an important paper which will be an important aspect of 2.3 as well – show that countries whose growth relied on manufacturing exports saw significant improvements in the quality of their institutions, while those whose growth derived from natural resource exports saw no improvement. In other words, the structure of the economy and the incentives it can create for private and public agents are fundamental for the long-term development of an economy.

2.2. What does Africa make? What does it export?

Real GDP in Africa has grown by an average of 5.5% between 2000 and 2010, more than double the average growth rate from 1980 to 1995. However, structurally the economy of the continent has not progressed. Indeed, industry has declined both as a share of global production and trade. In 2005, African manufacturing value-added totaled USD 45.8 billion, of which almost 60% was accounted for by one country - South Africa. Indeed, excluding South Africa, manufacturing valued added was less than USD 30 per capita (and making up on average less than 8% of GDP), compared to USD 82 for South Asia (15% of GDP) and USD 583 (30% of GDP) for East Asia and the Pacific.

21 Akinlo (2012), p.168  
23 IMF (2011), p. 15  
24 Page (2010), p.1  
25 UNIDO (2009). p.132  
26 Ibid, p. 136
Table 1: Top 10, Manufacturing Value Added (2009)

<table>
<thead>
<tr>
<th>Country</th>
<th>Value Added (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. South Africa</td>
<td>38 845 723 101</td>
</tr>
<tr>
<td>2. Angola</td>
<td>4 586 022 590</td>
</tr>
<tr>
<td>3. Cote d’Ivoire</td>
<td>4 186 697 615</td>
</tr>
<tr>
<td>4. Sudan</td>
<td>3 511 954 528</td>
</tr>
<tr>
<td>5. Kenya</td>
<td>2 801 459 948</td>
</tr>
<tr>
<td>6. Tanzania</td>
<td>1 844 077 853</td>
</tr>
<tr>
<td>7. Ghana</td>
<td>1 759 227 712</td>
</tr>
<tr>
<td>8. Equatorial Guinea</td>
<td>1 641 302 368</td>
</tr>
<tr>
<td>9. Senegal</td>
<td>1 489 884 157</td>
</tr>
<tr>
<td>10. Mauritius</td>
<td>1 483 299 956</td>
</tr>
</tbody>
</table>

Source: World Bank World Databank 2012

Table 2: Top 10, Manufacturing Value Added as % of GDP (2009)

<table>
<thead>
<tr>
<th>Country</th>
<th>% of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Swaziland</td>
<td>44,7</td>
</tr>
<tr>
<td>2. Mauritius</td>
<td>19,4</td>
</tr>
<tr>
<td>3. Cote d’Ivoire</td>
<td>18,2</td>
</tr>
<tr>
<td>4. Zimbabwe</td>
<td>17,0</td>
</tr>
<tr>
<td>5. Lesotho</td>
<td>16,0</td>
</tr>
<tr>
<td>6. South Africa</td>
<td>15,2</td>
</tr>
<tr>
<td>7. Namibia</td>
<td>14,7</td>
</tr>
<tr>
<td>8. Madagascar</td>
<td>14,1</td>
</tr>
<tr>
<td>9. Mozambique</td>
<td>13,6</td>
</tr>
<tr>
<td>10. Equatorial Guinea</td>
<td>13,6</td>
</tr>
</tbody>
</table>

Source: World Bank World Databank 2012

In terms of exports, manufactured goods have grown by an average of 13% in Africa (roughly the same rate when South Africa is excluded), though from a very low base. In 2005, Africa exported USD 58 billion in manufactures, of which 55% was accounted for by South Africa.\(^{27}\) East Asia, in comparison, exported USD 1.8 trillion in manufactured goods, ten times more per capita than Africa and twenty times more if South Africa is excluded.\(^{28}\) Looking at the level of sophistication of African manufactured exports (exc. South Africa), 75% were resource-based (e.g. timber) and only 13% were medium or high-technology goods.\(^{29}\) In the 2011 Regional Outlook, the IMF finds the overall level of sophistication of Africa’s merchandise exports has been quite static. Indeed, the “success stories” in moving up the value chain tend to be

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\(^{27}\) UNIDO (2009), p. 113  
\(^{28}\) Ibid, p. 136  
\(^{29}\) Ibid, p. 134
agricultural goods, such as cut flowers and coffee. According to UNIDO figures, manufactures have increased as a share of exports over the last several decades, though this reflects largely the decline in primary product prices rather than a boom in manufacturing.

Table 3: Top 10, Manufactured Exports per Capita (2009)

<table>
<thead>
<tr>
<th>Country</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Botswana</td>
<td>1360</td>
</tr>
<tr>
<td>2. Mauritius</td>
<td>976</td>
</tr>
<tr>
<td>3. South Africa</td>
<td>594</td>
</tr>
<tr>
<td>4. Gabon</td>
<td>168</td>
</tr>
<tr>
<td>5. Cote d’Ivoire</td>
<td>86</td>
</tr>
<tr>
<td>6. Senegal</td>
<td>69</td>
</tr>
<tr>
<td>7. Zimbabwe</td>
<td>62</td>
</tr>
<tr>
<td>8. Ghana</td>
<td>60</td>
</tr>
<tr>
<td>9. Kenya</td>
<td>41</td>
</tr>
<tr>
<td>10. Madagascar</td>
<td>30</td>
</tr>
</tbody>
</table>

Source: World Bank World Databank 2012, author’s calculations

Looking at where African manufacturers export is also illuminating. Looking at firm survey data from seven African countries, Yoshino (2008) finds that firms exporting within a sub-region are likely to expand to other markets within Africa, but not to global markets. Those firms that export outside of Africa (e.g. to Europe which imports roughly half of Africa’s manufactured exports) are likely to expand to other non-African markets, but not within the continent. In other words, “little overlap is found between intra-Africa regional exporters and exporters to countries outside Africa.”

Another interesting finding from earlier work is that most large African manufacturing firms (with 100 employees or more) do export, but export small amounts (on average less than 30% of output). Given the relatively small size of African markets, this finding has important implications. If the large firms are able to break into export markets, why have they not expanded their presence, through expanding the volume of their output exported? Bigsten et al (1999) venture that African firms do not want to specialize as this carries more risk, though they offer no concrete conclusion.

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30 IMF (2011), p. 49
31 Lawrence (2005), p.1
32 Yoshino (2008), p. 22
33 Bigsten et al (1999), p. 56
2.3. What’s preventing Africa’s manufactured export growth?

To understand the current situation, it is useful to set the background of modern manufacturing in Africa. Following the wave of independence in the late 1950’s and early 1960’s, many African economies turned to import substitution industrialization (ISI) programs in an effort to promote domestic industries to get off the ground. Though initially well-intentioned, in general these efforts created highly inefficient oligopolies which tended to lose significant amounts of money. Lawrence (2005) argues that these programs were not part of a well-structured industrial plan, rather “a dependent and unplanned industrialization linking domestic manufacturing to foreign investors/suppliers, mainly multinational companies.”

Manufacturers were dependent on foreign inputs; even when domestic sources could be exploited, creating larger and larger demand for foreign exchange while simultaneously reducing the economic logic of domestic production. The lack of technical absorption capacity and negotiating power (or perhaps, will) on the side of the government resulted in little positive spillovers from the foreign technology and in general, repatriation of a significant share of profits. Lawrence’s over-arching explanation for this rests on the absence of a capitalist class; in its place was a ruling political elite more focused on consumption and rent-seeking.

Turning from political economy explanations to applications of trade theory, different arguments have been presented to the lack of manufacturing export dynamism. The Heckscher-Ohlin model of international trade hypothesizes that what a country exports depends on its factor endowments, most commonly labor and capital. Wood and Mayer (2001) use this model to explain Africa’s propensity to export primary rather than manufactured goods. The authors argue that Africa’s low level of skilled labor and high level of land resources gives it a comparative advantage in unprocessed primary products. However, given the discussion earlier on the growth implications of relying on primary goods, this model predicts a rather pessimistic view for Africa’s future. More importantly, there is a body of data which shows that education levels found in Africa today, though far from developed country standards, are not appreciably different.

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34 Lawrence (2005), p. 1127
35 Ibid, p. 1130
from those of the East Asian countries at the beginning of their manufacturing export take-offs.\textsuperscript{36}

A somewhat more persuasive line of reasoning seeks to answer the question using micro-foundations. In other words, instead of asking why aren’t African countries exporting more manufactures, the more interesting question is why are African firms not exporting more manufactures? This line of investigation examines the different factors which influence a firm’s ability to export and compete internationally. Within the same industry, African firms are far from homogenous: data shows the variation in productivity to be significantly higher than for similar industries in East Asia.\textsuperscript{37} Further, within an industry, the propensity to export depends on firm-specific factors.\textsuperscript{38}

So what constrains African manufacturing firms? Manufacturing tends to be relatively capital intensive, so credit constraints are important to consider. Wood and Mayer (2001) argue that capital is so mobile today that access to credit depends only on the profitability of the given enterprise.\textsuperscript{39} However, many empirical findings show this to be overly simplistic. Capital markets in Africa tend to be quite shallow and information asymmetries pervasive, making banking more risky than in other parts of the world. Indeed, the leading constraint cited by company managers in the World Bank’s Enterprise Surveys is financing.\textsuperscript{40} Bigsten et al. (2003) examine firm-level surveys and show that one-third of firms are credit constrained, and the size of the firm is a significant and positive predictor of access to credit (i.e. micro and small firms are the most likely to be constrained by credit).\textsuperscript{41} Further, Habyarimana (2004) finds that Ugandan firms which lost a banking relationship due to an exogenous shock (in this case, several high-profile bank bankruptcies) showed average growth rates 2 to 4 percentage points lower than those of unaffected firms.\textsuperscript{42}

In terms of the other key input, labor, most findings show that labor unit costs are smaller in Africa than in East Asia, even when accounting for productivity differences.\textsuperscript{43}

\begin{thebibliography}{9}
\bibitem{36} Johnson, Ostrey and Subramanian (2007), p. 24
\bibitem{37} Söderbom (2001)
\bibitem{38} Bigsten et al (1999), p.66
\bibitem{39} Bigsten and Södebo (2001), p.372
\bibitem{40} Wood and Mayer (2001), p. 372
\bibitem{41} Bigsten et al. (2003), p. 11
\bibitem{42} Bigsten et al. (2003). p.12
\bibitem{43} Teal (1999), Cadot and Nasir (2001), Gelb and Tidrick (2000)
\end{thebibliography}
However, firm heterogeneity rears its head: smaller firms pay significantly lower wages than large firms. Bigsten et al. (2003) cite the case of Ghana where a firm with 350 employees could reduce its total costs by 20-25% if it faced the same unit labor costs as a firm with 20 employees.\footnote{Bigsten et al. (2003), p.15}

Economists often cite the importance of skilled labor in modern manufacturing. Wood and Benge (1997) find that the low ratio of skills to land found in the majority of African countries restricts these economies to the export of raw materials compared to their Asian counterparts. Zeufack (2000) refutes these claims, citing methodological identification issues. Instead of looking at aggregated data, Zeufack uses firm-level observations from Ghana, Kenya and India and finds that skills cannot explain export performance differences. Rather, he argues that differences in institutional quality and rule of law have robust explanatory power.\footnote{Zeufack (2000), p. 277} Indeed, this is a broad trend in the development literature: modeling must rely more on disaggregated micro-level assumptions, rather than assuming heterogeneity among firms (see e.g. Banerjee and Duflo (2004)).

Further, there are important indirect costs which must be addressed. Africa, on average, suffers from the weakest infrastructure in the world. Paved road density in Africa’s low income countries is less than a quarter of the average in similar countries in the developing world.\footnote{Foster and Briceño-Garmendia (2010), p.212} Foster and Briceño-Garmendia (2010) estimate than an additional 60,000 to 100,000 km of roads is needed to connect the continent and its vital ports.\footnote{Ibid, p. 214} Bigsten and Söderbom argue that the prevalence of small scale manufacturing in Africa is due to the poor transport infrastructure which skews the economic rationale towards localized production. Limão and Venables (2001) find that improving Africa’s transport infrastructure would significantly boost both intra and inter-continental trade. Clarke (2005) finds weak evidence for the quality of domestic transport infrastructure to be a constraint to exports, though he points out that land-locked countries (which tend to have higher transport costs) on average export less than coastal countries.\footnote{Clarke (2005), p.22} The Africa Infrastructure Country Diagnostic identified power as “by far Africa’s largest...
infrastructure challenge." Lack of a reliable power grid is a commonly cited constraint to manufacturing on the continent. Power outages tend be significantly more frequent in Africa than East Asia, and many firms rely on privately produced power, which can be up to ten times the cost of the public utility. 47% of African manufacturers surveyed report electricity to be a major obstacle to their operations.

Government regulation and dealing with taxation and customs authorities, key aspects of the business environment, are also cited as constraints to firms. In African manufacturing, there appears to be a “missing middle” in terms of firm size. There are a large number of micro and small enterprises and a smaller number of large-scale firms, but there are few firms straddling this middle. Bigsten and Söderbom (2006) argue that small firms do this primarily to avoid excessive regulation. Staying small (and often informal) reduces investment, productivity, and the likelihood of exporting.

Consistent with this, African exporters are significantly more likely to complain of trade and customs regulations as a serious obstacle than their East Asian counterparts. For example, exports take 12 days to clear in Tanzania compared to 3 days in the Philippines, adding significant delays. Government schemes to encourage exports, such as duty drawback mechanisms, are also often poorly administered and exporters must wait for extended periods to receive payment.

Manufacturing is further constrained by the weak legal environment. Contract enforcement and protection of property rights are difficult in such an environment, making large investments more risky and less productive. For example, Collier and Gunning (1999) show that only in 10% of legal disputes are lawyers hired, illustrating the fact that in many African countries, turning to the courts is often not a practical option. Unsurprisingly, Africa scores lower than any other developing countries on an index of contract enforceability. Further, Collier argues that the tradables sector, in particular manufacturing, is the most likely to be affected by this environmental weakness.

49 Foster and Briceño-Garmendia (2010). p. 1
51 Foster and Briceño-Garmendia (2010). p.5
52 Bigsten and Söderbom (2011). p.16
53 Clarke (2005). p.8
54 Ibid. p.10
55 Collier and Gunning (1999). p.84
However, whether the institutional weaknesses pervasive in Africa are a binding constraint to the manufacturing sector (especially in expanding its exports) is not clear. Johnson, Ostrey and Subramanian (2007) identify 12 “sustained growth” countries primarily in East Asia and analyze their level of institutions at the beginning of their growth acceleration. The authors find that these 12 countries (10 of which relied on manufacturing exports for their growth) had, on average, institutions that were significantly weaker than those of most African countries today. Further, they find that the quality of infrastructure and level of education are comparable to Africa’s levels at present. In other words, these dozen success stories (which include China and seven other East Asian countries) were not necessarily much better off in broad terms when they began their rise.
3. Currency undervaluation: What does it mean? How does it work?

“Tensions are rising over Chinese economic policy, and rightly so: China’s policy of keeping its currency, the renminbi, undervalued has become a significant drag on global economic recovery. Something must be done.”

- Paul Krugman

Interest in currency issues has moved from the domain of academic economists to the common man due to widespread accusations (and as Krugman shows, often anger) that China is manipulating its currency in order to promote its export sector. In 2010, China’s merchandise exports totaled USD 1.6 trillion, making it the world’s largest exporter, surpassing both Germany and the United States. How does undervaluing the Chinese renminbi play a role in the country’s success?

According to IMF classifications, most developed countries, from the Euro zone to the United States, have free floating currencies. This means that the national central banks do not actively interfere in managing the currencies. In contrast, The People’s Bank of China (PBOC), the country’s central bank, plays an active role in managing the value of the renminbi. The PBOC buys foreign currencies, principally US dollars and Euros, with Chinese renminbi, simultaneously increasing the demand for these currencies and the supply of its own currency. In the first half of 2011, China’s foreign reserves increased by an estimated USD 350 billion, pushing up its total holdings to USD 3.2 trillion, almost three times that of Japan, the next largest foreign reserve holder. The effect is that the relative supply of foreign currencies to renminbi remains low, making the relative price between the monies higher (i.e. each dollar buys more renminbi). This gives Chinese exporters an edge in global markets, as their prices are more attractive to foreign (primarily American and European) consumers. Exact estimates of the extent of the Chinese undervaluation vary and are the subject of heated political and academic debate. A small cadre of economists (including the World

57 CIA World Factbook
60 See e.g. Subramanian (2010), Bergsten (2010), Cline and Williamson (2010)
Bank chief economist Justin Lin) even argues that the renminbi is in fact close to equilibrium.\textsuperscript{61}

This chapter looks first at the different measures used to estimate levels of the “correct” exchange rate in order to provide a basis for understanding how under- and overvaluation are measured. Given this necessary background, the empirical and theoretical evidence for the effects of currency misalignments on economic performance are presented.

### 3.1. Measuring RER misalignments

In a 2004 speech, the UCLA economist Arnold Harberger argued the real exchange rate is “the principal equilibrating variable of a country’s international trade and payments . . . and has an extremely important job to do in the economy.” Many economists are of the same mind. However, what exactly the real exchange rate is a more difficult question.

Whereas calculating a nominal exchange rate is simply arithmetic, estimating the real exchange rate is more complex and often a very subjective exercise. There are essentially two approaches to measuring the real exchange rate and any potential over- or undervaluation. The first is based on price comparisons and is relatively simply to calculate. The second method is based on more complex macroeconomic models for calculating the exchange rate which would bring external equilibrium.

#### 3.1.1. Price comparisons based RER measures

The real exchange rate is simply the purchasing power of one currency relative to another (or a basket of other currencies). Adjusting for purchasing power is done by dividing the nominal exchange rate by a GDP deflator. The most common such deflator is the purchase power parity (PPP) index which compares prices for similar baskets of goods. The World Bank’s International Comparison Program and the University of Pennsylvania’s Penn World Tables are the most comprehensive sources for calculating

\textsuperscript{61} Lin (2012), p.192
PPP estimates. Taking logarithms, the simplest measure of misalignment of currency (i) at any given time (t) is:

\[
\text{UNDERVAL}_{\text{BASE}} = \ln RER_{it} = \ln \left( \frac{XRAT_{it}}{\text{PPP}_{it}} \right)
\]

Where a value less than one implies overvaluation and a value above one implies undervaluation. Rodrik (2008) uses this as one of his measures for misalignment, using estimations from the Penn World Tables to calculate PPP. In the paper, however, he acknowledges the emergence of significant issues with the Penn World Table estimates and employs other deflators, such as Consumer Price Indices (CPI) and World Price Indices (WPI) where available. Rodrik’s preferred measure, and one used in several other papers including Freund and Pierola (2008) adjusts the above UNDERVAL for the Balassa-Samuelson (BS) effect. Assuming that productivity increases more rapidly in the tradable sector, productivity gains will expand this gap between the tradable and nontradables sectors. Increased productivity in the tradable sector will push up sectoral wages, while also putting upward pressure on wages in the economy as a whole, increasing the price of nontradables. Hence, higher productivity countries (high income countries) will have a relatively more appreciated currency. Rodrik estimates this effect by regressing the income per capita (and country and time effects) on the real exchange rate:

\[
\ln RER_{it} = \alpha + \beta \ln RGDPC_{it} + \zeta_t + \mu_{it}
\]

Rodrik finds that \( \beta \) equals -0.24. In other words, a 10% increase in per capita income correlates with a decrease in the real exchange rate of 2.4% (i.e. an appreciation of 2.4%). Using this \( \beta \) and plugging in a country’s per capita income level (RGDPCH), one can then estimate the Balassa-Samuelson effect for any given country. The Balassa-Samuelson adjusted estimation for undervaluation then becomes:

\[
\text{UNDERVAL}_{\text{BASE}} - \text{BS}_{it} = \ln \left( \frac{XRAT_{it}}{\text{PPP}_{it}} \right) - \left[ \alpha + \beta \ln RGDPC_{it} + \zeta_t + \mu_{it} \right]
\]

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62 Rodrik (2008), p. 379
It must be noted that there is a significant level of disagreement among economists regarding the importance of the Balassa-Samuelson effect. For example, Lothian and Taylor (2004) find the effect explains 40% of the variation in historical real exchange rates for the US dollar. Choudhri and Khan (2005) test for the effect in 16 developing countries and find strong evidence to support the hypothesis. On the other hand, studies such as Egert et al. (2003), looking at nine transition countries in Europe, find only a weak BS effect.

### 3.1.2. External Balance based RER measures

In an influential 1945 paper, the Estonian economist Ragnar Nurkse defined the equilibrium real exchange rate as the rate which achieves internal and external equilibrium. However, this is again not as simple as it may first appear. Williamson (1985) and Williamson (1994) introduce the concept of a fundamental equilibrium exchange rate (FEER), in which internal and external balances are achieved in the medium-term and are sustained. Misalignment is then measured as the level of deviation from this equilibrium rate. The internal balance is achieved when domestic output is consistent with the condition of full employment, i.e. non-accelerating inflation-rate unemployment (NAIRU). External balance is defined as the “sustainable” capital flows given that the two economies are in internal equilibrium.

Elbadawi and Soto (2005) discuss the issues with the FEER measure and highlight four key issues. First, the subjectivity of calculating the optimal current account balance, as this relies on judgmental approaches, rather than well-established theory. In other words, estimating the FEER is a normative, rather than a positive exercise. Second, FEER does not take into account other important medium-term variables, such as terms of trade, trade policies and aid/remittance flows which can have significant effects on the currency’s value. Third, the measure does not take into account long-term stock equilibrium considerations and lastly, it does not deal with the dynamics of adjustment, essentially ignoring the effects of exchange rate and monetary policy on the speed of convergence.

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63 Elbadawi and Soto (2005), p.8
64 Ibid, p.9-10
Clark and Macdonald (1998) offer a model which attempts to address some of the key shortcomings of the FEER model. For example, the authors point out, the FEER approach does not include the exchange rate as determinant of saving and investment, though this should clearly have effects on these fundamental rates. Clark and Macdonald offer instead a Behavioral Equilibrium Exchange Rate (BEER) approach. In this model, the misalignment can be calculated as the difference between the actual real exchange rate (ARER) and the equilibrium real exchange rate (ERER), given respectively by:

\[ ARER_t = \beta_1 Z_{1t} + \beta_2 Z_{2t} + \tau T_t + \varepsilon_t \]
\[ ERER_t = \beta_1' Z_{1t} + \beta_2' Z_{2t} \]
\[ MIS_t = ARER_t - ERER_t = \tau T_t + \varepsilon_t \]

Where ARER is influenced by short-term, transitory variables (vector \( T_t \)) as well as medium and long-term term fundamentals (\( Z_{1t} \) and \( Z_{2t} \)), while ERER is affected only by the former.

In its exchange rate assessments, the IMF uses three measures, based largely on the FEER model.\(^6\) In section six, this paper will present the most recent IMF estimates of the alignment of Africa’s currencies using primarily these three approaches.

**Macroeconomic Balance (MB) approach**

This approach uses country-specific elasticities of the current account with respect to the real exchange rate (i.e. how imports and exports respond to changes in the RER) to calculate what rate would bring the current account into equilibrium in the medium term. The difference between this rate and the current market rate gives the estimated misalignment.

Econometric models are used to project the current account into the medium term, most often the next five-year period. A number of factors affect the current balance and are included in the models. Fiscal balance and foreign reserve levels, oil balance (net

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\(^6\) IMF (2011a).
importer vs. exporter), demographics, economic growth and role of external finance in the economy all affect the current account through various channels. For example, demographics can influence the current account as an ageing population puts downward pressure on the savings rate and consequently the current account. A country’s oil balance will affect the amount it will need to either commit in foreign reserves to purchase energy on the market if it is a net importer or the inflow of foreign currency if it is a net exporter.

This projection of the medium-term current account is then used to calculate what level of exchange rate would bring external equilibrium (i.e. a current account balance of zero). The elasticity of the current account with respect to the RER \( \eta_{CA} \) is calculated using a weighted average of the import and export elasticities with respect to RER:

\[
\eta_{CA} = \left( \eta_{EXP} \times \frac{EXPORTS}{GDP} \right) - \left( (\eta_{IMP} - 1) \times \frac{IMPORTS}{GDP} \right)
\]

The more open the economy, the smaller the exchange rate adjustments will need to be in order to achieve equilibrium.

*Equilibrium Real Exchange Rate (ERER) approach*

The ERER approach looks to model RER behavior with macroeconomic fundamentals. Variables such as net foreign assets (NFA), productivity differentials between the tradable and the non-tradable sector (to quantify the Balassa-Samuelson effect discussed earlier), commodity terms of trade, government consumption and price controls have differing effects on the real exchange rate. High net foreign assets (i.e. being a net creditor) “afford” the country the possibility of an appreciated currency as there is less pressure to boost the export sector in order to generate foreign currency to service external liabilities. Commodity terms of trade, the weighted average of main commodity exports vs. imports, affect the real exchange rate through real income affects. Government consumption tends to be channeled toward non-tradables, hence an increase in consumption would likely result in an increase in the relative price of non-tradables to tradables, hence appreciating the currency.
Once these effects are modeled econometrically, the real exchange rate which would bring the economy into external equilibrium in the medium term (again, a zero current account balance) can be estimated. The misalignment is then simply the difference between the actual prevailing rate and this equilibrium rate.

*External Sustainability (ES) approach*

The external sustainability approach seeks to estimate the real exchange rate which would bring the current account balance to a given benchmark level over the medium term. This benchmark level is calculated as one which would stabilize the country’s net foreign assets position and depends on a few fundamentals, namely the current NFA position, projected economic growth and the rate of return on domestic and foreign assets. Calculating the RER which would achieve this benchmark is then calculated using the macroeconomic balance approach outlined earlier.

**3.2. Why is overvaluation bad for economic growth?**

Though the rhetoric has entered the public domain in the last few years, the role of undervaluation in economic policy of developing countries extends back much further. However, the positive effect of an undervalued exchange rate is not uncontroversial among economists, and in this section the paper will analyze recent thinking.

Before turning to the more contentious links between undervaluation and economic performance, let us examine the broad economic consensus on why an overvalued currency hampers economic growth. Empirical evidence is relatively consistent in showing a significantly negative correlation between an overvalued currency and economic growth. Using cross-country data on 93 countries from 1975-1993, Razin and Collins (1997) find that an overvaluation of a country’s real exchange rate (RER) of 10% is associated with a reduction in the growth of per capita output of 0.6%. Aghion et al (2006) find real exchange rate overvaluation to be negatively correlated to productivity growth, especially in countries with shallow financial markets (e.g. Africa). Looking at a similarly large country sample as Razin and Collins, but over a

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66 Razin and Collins (1997), p.16
significantly longer period (1960-2000), the authors find that a 20% overvaluation is associated with 0.2% reduction in annual productivity growth. The manufacturing tradable sector, which is negatively affected by an overvalued currency, tends to be a key source of productivity advances for developing countries as they are engaged in the competitive nature of the global market and often can benefit from increased technological knowhow (i.e. learning by exporting effects, as discussed earlier).

Rajan and Subramanian (2011) examine the effects of foreign aid inflows on the competitiveness of manufacturing exports. The authors’ analysis shows a negative and robust correlation between manufacturing and aid (as shares of GDP). The mechanism behind this correlation, the paper argues, is exchange rate overvaluation. Aid inflows increase the relative price of nontradables, resulting in the appreciation of the currency. The “excess” real exchange rate appreciation dampens the competitiveness of the manufacturing export sector; hence we see a decline in the share of manufacturing in the economy. Rajan and Subramanian’s empirical work shows that a one percentage point increase in excess appreciation (i.e. overvaluation) reduces average growth in the exportable sector by 0.2%. The authors conclude: “manufacturing exports provided the vehicle for their [fast-growing developing countries] growth take-off, so any adverse effects on such exports should prima facie be a cause for concern.”

An overvalued exchange rate can hurt an economy through several other important channels. First, an overvalued exchange rate makes imports relatively cheaper, making import-competing firms less competitive. This often results in lobbying on the part of these firms to increase trade protections (tariffs and quotas), closing the economy to international competition and reducing access to foreign inputs and technologies (often vital for manufacturing machinery). More broadly, the losers in a move away from an overvalued currency are often what John Williamson describes as the “urban salariat”, primarily government workers and other urban consumers in which “political power tends to be concentrated.” Such a vested interest seeks to protect its short term interests at a significant cost to the growth of the broader economy. Second, governments often have to follow tight monetary policy to maintain the overvaluation.

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67 Rajan and Subramanian, p. 113
68 Ibid, p. 115
70 Williamson (1997), p.30
resulting in increased costs in borrowing for firms and an overall downturn in the economy (or worse, severe recession). Lastly, the difficulty of maintaining the overvaluation may push domestic investors to send their capital abroad, fearing an eminent depreciation. Indeed, currency crises have most often been preceded by a persistent overvaluation.\textsuperscript{71}

3.3. **Undervaluation: good or bad?**

The evidence, both theoretical and empirical, for the harmful nature of currency overvaluation is clear. This begs the important question: if an overvalued exchange rate is bad for manufacturing exports (and economic growth), is an undervalued exchange rate good? On this there is much less consensus.

Many economists contend that any exchange misalignment is deleterious as economic agents receive distorted price signals. Just as real exchange overvaluation can lead to current account deficits and fiscal instability, an undervalued exchange rate can drive inflation and the overheating of an economy.\textsuperscript{72} Aguirre and Calderon (2005) look at data for 60 countries from 1965-2003 and find that misalignment in either direction has an adverse effect on growth, though with the caveat that small levels of undervaluation (misalignment of less than 12\%) are correlated with positive growth.\textsuperscript{73}

Other economists accept that an undervalued currency can drive export competitiveness, though only in the short term and depends on getting a number of other policy variables right. Eichengreen (2008) argues that an undervalued exchange rate can be an important facilitating condition for growth, but cannot act as a “substitute for the presence of a disciplined workforce, high savings, or a foreign-friendly investment.”\textsuperscript{74} Eichengreen also argues that a prolonged undervaluation may tilt the economy too far in favor of the export-sector, at the expense of non-export regions within a country, creating domestic imbalances (not to mention international tensions, e.g. US vs. China).

\textsuperscript{71} Elbadawi and Soto (2005), p.32
\textsuperscript{72} Haddad and Pancaro (2010), p. 2
\textsuperscript{73} Aguirre and Calderon (2005), p.31
\textsuperscript{74} Eichengreen (2008), p.20
However, there is a strong body of empirical evidence, which points to undervaluation playing a key role in the economic development experience in the post-war period, particularly in East Asia. Perhaps the most vocal proponent of this line of thinking is the Harvard economist Dani Rodrik. Using panel data on growth for 188 countries from 1950 to 2004, Rodrik (2008) finds undervaluation to be a significant explanatory variable in growth regressions, though only for developing countries (defined as per capita incomes of less than USD 6000). For developing countries, he finds that a 50% undervaluation (see section 3.2 for different measures of undervaluation) correlates with a 1.3% increase in per capita income growth.\(^{75}\) Moreover, Rodrik highlights the robust effect of undervaluation in the structural transformation of an economy. His analysis shows the same 50% undervaluation correlates with an increase in the share of industry in total employment by 2.1 percentage points. This is a relatively large shift given industrial employment typically accounts for about 20% of total employment in developing countries.\(^{76}\) Section four will look at the mechanisms, which Rodrik argues, connect the correlation.

In response to Rodrik’s paper, Woodford (2009) airs some skepticism which is important to address. On the empirical front, Woodford points out that Rodrik’s cut-off of USD 6000 for developing countries is somewhat arbitrary, and re-running the regressions with a cut-off of USD 8000 significantly reduces the explanatory power of undervaluation.\(^{77}\) However, given the majority of Africa’s economies are well under USD 6000 per capita, this is not a fundamental concern for this paper. More relevant to this thesis is Woodford’s theoretical argument. He contends that increased savings, induced either through government or a change in preferences, is the key mechanism which stimulates production in the tradables sector. The increased production simultaneously will increase the real exchange rate (i.e. depreciate the currency) and spur economic growth. In other words, the correlation between undervaluation and economic growth is endogenously driven by the savings rate.\(^{78}\) Indeed, Woodford argues, a policy targeted at nominal undervaluation would have no effect as prices would simply rise to reflect the change. He agrees avoiding overvaluation is prudent, but points out this must be distinguished from pursuing undervaluation.

\(^{75}\) Rodrik (2008), p.374
\(^{76}\) Ibid, p.391
\(^{77}\) Woodford (2009), p.8
\(^{78}\) Ibid, p.13
Haddad and Pancaro (2010) voice similar concerns regarding the inflationary pressure of undervaluation, but find that a significant undervaluation correlates with stronger export performance and growth in low income countries in the short to medium term. In economies with a GDP of less than USD 2500 per capita, a 50% undervaluation correlates to a 1.8% increase in exports (as a share of GDP) and a 1.7% increase in the per capita income growth rate, though these positive effects disappear in the longer term.⁷⁹ Indeed, the paper highlights important long-term concerns in the including the inefficiency of holding low yielding foreign reserves, the constraint on monetary policy to affect domestic objectives and skewing the economy too heavily towards the export sector.

Freund and Pierola (2008) examine 92 episodes of manufacturing export “surges”. They define a surge as “significant and sustained increase in manufacturing export growth from one seven-year period to the next.”⁸⁰ The authors find that surges are preceded by large currency depreciations, especially in developing countries where the depreciation results in an average undervaluation of the currency of 20%.⁸¹ In line with Rodrik’s findings, Freund and Pierola contend the undervaluation is a key driver in restructuring the economy. Larger undervaluations drive rapid expansions into new markets and product lines for developing country exporters, acting as a big push or “grand opening sale.” The authors show that undervaluation speeds up the shifts from initial revealed comparative advantage industries (e.g. more traditional sectors) to newer industries.⁸²

Levy-Yeyati and Sturzenegger (2007) examine the dramatic shift of exchange rate policy in developing countries over the last three decades. In the 1980’s, the majority of developing countries (especially in Latin American and Africa) intervened in the currency markets to defend their overvalued exchange rates. Following the debt crises of the 1980’s and 1990’s, many developing countries have increasingly intervened in the opposite direction, i.e. to keep their currencies undervalued.⁸³ The authors’ analysis shows that these later interventions have had significantly positive impacts on both

⁷⁹ Haddad and Pancaro (2010). p. 2
⁸⁰ Freund and Pierola (2008). p.3
⁸¹ Ibid, p.13
⁸² Ibid, p.18
short and long run growth. Their argued mechanism for this growth differs from both Rodrik and Freund and Pierola. Levy-Yeyati and Sturzenegger contend that the growth is not driven by increased export volumes, but rather by an increase in firm-level investment driven by a reduction in labor costs (a depreciated currency reduces real wages). In developing countries, firms are often financially-constrained and the freeing up of capital allows them to invest productively, hence driving growth.\(^{84}\) This story is however at odds with Freund and Pierola, who find no evidence that the domestic investment rate increases with undervaluation.\(^{85}\)

Bhalla (2008) finds the strongest effects of undervaluation on GDP growth. He finds the change in undervaluation, rather than the initial level, to be the significant predictor. Each 1% annual increase in undervaluation leads to an increase in GDP growth of 0.3 to 0.4%, whereas each 1% of initial undervaluation correlates with only a 0.01% increase in the growth rate.\(^{86}\) Bhalla argues that half of China’s miraculous growth in 1970-2004 can be explained by its aggressive policy of exchange rate devaluation.\(^{87}\) The author’s proposed mechanism is broadly similar to Levy-Yeyati and Sturzenegger’s in that the reduction in real wages drives increased investment, though he includes both foreign and domestic.\(^{88}\)

Other empirical work which corroborate the positive link between undervaluation and economic performance include Gala (2007), Berg and Miao (2010), and MacDonald and Vieira (2010). Korinek and Serven (2010) develop a dynamic welfare model which illustrates the effects of an undervaluation on economic growth based on learning-by-investing spillover effects and will be presented in detail in chapter five.

Before delving into the theoretical models on undervaluation, it is important also to highlight the importance of exchange rate stability on economic performance. According to basic microeconomic principles, higher currency volatility would create increased risk for exporting firms, and could reduce production and investment by more risk-averse agents in a scenario with limited hedging tools. Addressing the question with empirical evidence, Sauer and Bohara (2001) find that the exports of developing

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\(^{84}\) Levy-Yeyati and Sturzenegger (2007), p.16
\(^{85}\) Freund and Pierola (2008), p.14
\(^{86}\) Bhalla (2008), p.338
\(^{87}\) Ibid, p. 336
\(^{88}\) Ibid, p. 328
countries in Latin America and Africa are particularly sensitive to exchange rate volatility compared to their OECD and East Asian counterparts. Looking more specifically at African manufactured exports - the focus of this thesis – Sekkat and Varoudakis (2000) find that exchange rate volatility coupled with significant overvaluation significantly harmed the performance of African manufacturers in the global market.
4. Reducing the Tax on Tradables: The Rodrik Model

Rodrik’s model is a theoretical explanation of his idea that the tradable sector is affected more adversely by the weak institutional environment in developing countries than the nontradables sector. Undervaluation acts as an implicit subsidy for the tradable sector, avoiding the problems of rent-seeking and inefficiency associated with a government directly picking winners through more direct subsidies.

The model begins with a basic Cobb-Douglass single-good production function \( y \) with two inputs, tradables \( (y_T) \) and non-tradables \( (y_N) \), which are produced using only capital \( (k) \), and subject to decreasing returns to scale \( (0 < \varphi < 1) \). The quantity of non-tradable inputs \( (y_N) \) is, by definition, determined by the domestic production \( (q_N) \), while the amount of tradable inputs in production depends on the domestic production \( (q_T) \) and the amount of imported (or exported) tradable inputs \( (b) \). The share of capital devoted to production of tradables is \( \theta_T \) and \( b \) refers to the net inflow from tradables and is expressed as a share \( \gamma \) of the total domestic demand for tradables (i.e. \( \gamma < 0 \) implies net exports).

\[
\begin{align*}
    y &= k^{1-\varphi} y_T^\varphi y_N^{1-\alpha} \quad (4.1) \\
    y_N &= q_N = A_N \left[ (1 - \theta_T) k \right]^\varphi \quad (4.2) \\
    y_T &= q_T + b = A_T (\theta_T k)^\varphi + \gamma y_T \quad (4.3)
\end{align*}
\]

The aggregate production function can now be written:

\[
y = (1 - \gamma)^{-\alpha} A_T^\alpha A_N^{1-\alpha} \theta_T^{\alpha \varphi} (1 - \theta_T)^{(1-\alpha)\varphi} k \quad (4.4)
\]

Calculating net output \( (\bar{y}) \), we must subtract (add) the payments for imported (exported) tradable inputs. The payment is a given percentage \( (\sigma) \) of the input’s contribution to output (e.g. when \( \sigma \) equals unity, all of the marginal return from the use of the input is captured in the payment).
\[
\sigma \left( \frac{dy}{db} \right)_b = \sigma \left( \frac{dy}{dy_T} \right)_y y_T = \sigma \left( \frac{\alpha}{y_T} \right)_y y_T = \sigma \alpha y
\]
\[
\tilde{y} = y - \sigma \alpha y
\]
\[
\tilde{y} = (1 - \sigma \alpha y)(1 - y)^{-\alpha} A_T^\alpha A_N^{1-\alpha} \theta_T^{\alpha \phi} (1 - \theta_T)^{(1-\alpha)\phi} k \quad (4.5)
\]

The marginal return to capital (r) can be expressed by differentiating the net output function with respect to capital:

\[
r = \frac{d\phi}{dk} = (1 - \sigma \alpha y)(1 - y)^{-\alpha} A_T^\alpha A_N^{1-\alpha} \theta_T^{\alpha \phi} (1 - \theta_T)^{(1-\alpha)\phi} \quad (4.6)
\]

First, taking the log of r, then differentiating with respect to the share of capital allocated to tradables (\(\theta_T\)) and solving for the optimal share, we find that the return to capital is maximized when the capital share devoted to tradables equals the input share of tradables in the final production function (\(\alpha\)).

\[
\ln(r) = \ln(1 - \sigma \alpha y) - \alpha \ln(1 - y) + \alpha \ln(A_T) + (1 - \alpha) \ln(A_N) + (\alpha \phi) \ln(\theta_T) + \phi(1 - \alpha) \ln(1 - \theta_T)
\]
\[
\frac{d\ln(r)}{d\theta_T} = \phi \left[ \frac{\alpha}{\theta_T} - \frac{1 - \alpha}{1 - \theta_T} \right] = 0
\]
\[
\theta_T = \alpha
\]

Let us introduce now the sectoral taxation on profits (\(\tau_T, \tau_N\)) which can be used as a proxy for the effect of the weak institutions on each respective sector, and the real exchange rate (\(R\)) which is simply the ratio of the price of tradables to non-tradables (\(P_T/P_N\)).

The allocation of capital between the tradable and non-tradable sectors depends on its respective profit function and relative demand. Capital will be allocated such that returns (i.e. marginal product) are equalized between the two sectors.

\[
(1 - \tau_T) P_T \varphi A_T(\theta_T k)^{\phi-1} = (1 - \tau_N) P_N \varphi A_N [(1 - \theta_T) k]^{\phi-1}
\]
\[
(1 - \tau_T) R \varphi A_T(\theta_T k)^{\phi-1} = (1 - \tau_N) \varphi A_N [(1 - \theta_T) k]^{\phi-1}
\]
\[
\left[ \frac{\theta_T}{1 - \theta_T} \right]^\varphi = \left[ \frac{1 - \tau_T}{1 - \tau_N} \right] \left( \frac{1}{R} \right) \left( \frac{A_N}{A_T} \right)
\]  

(4.7)

On the demand side, the share for each sector is determined by the Cobb-Douglass preferences \((\alpha)\):

\[
\alpha y = P_T y_T = P_T \left( \frac{1}{1 - \gamma} \right) q_T = P_T \left( \frac{1}{1 - \gamma} \right) A_T (\theta_T k)^\varphi
\]

\[
(1 - \alpha) y = P_N y_N = P_N q_N = P_N A_N [(1 - \theta_T)k]^\varphi
\]

Taking the ratios of the two expressions and rearranging we have the demand-side relationship between the capital share of tradables \((\theta_T)\) and the real exchange rate \((R)\).

\[
\left[ \frac{\theta_T}{1 - \theta_T} \right]^\varphi = (1 - \gamma) \left[ \frac{\alpha}{1 - \alpha} \right] \left( \frac{1}{R} \right) \left( \frac{A_N}{A_T} \right)
\]  

(4.8)

Below we see the demand \((DD)\) and supply curves \((SS)\) which relate the real exchange rate to the capital share dedicated to tradables. The demand curve is negative sloping, as an increase in the real exchange rate makes tradables more expensive, hence reducing the demand for tradables and subsequently the amount of capital allocated to the sector.
Turning to the effects of taxation (Rodrik’s proxy for institutional weaknesses which reduce profitability) in capital allocation, it is straightforward to see from the earlier marginal product equations that when the two sectors are taxed at the same rate, the equilibrium above holds. However, if we now change the rates to incorporate Rodrik’s argument that the tradable sector is more heavily taxed by institutional constraints (i.e. $\tau_T \geq \tau_N$), we see a shift from the initial equilibrium (0) to a new equilibrium (1). This is driven by the reduced profitability of the tradable sector, and hence less capital is allocated to this sector than in the optimal case ($\theta_T < \alpha$), hence the economy will experience reduced growth.

Rodrik’s argument is that a policy which will depreciate the currency will act as a second-best solution for increasing the capital share allocated to tradables closer to the optimal level ($\theta_T \rightarrow \alpha$). A decrease in the level transferred abroad ($\gamma$) will induce this rise in the real exchange rate, increasing the demand for tradables (given the increased price attractiveness), moving the economy to a new equilibrium (2).
5. Korinek-Serven Model: Welfare Implications

Korinek and Serven (2010) develop a more comprehensive theoretical model on undervaluation and growth. Like Rodrik (2008), the authors assume the tradable sector is special in its capacity to generate economic growth. While Rodrik argues that the tradable sector suffers disproportionately from domestic institutional factors, Korinek and Severn reason that the tradable sector creates higher learning-by-investing externalities (an extension of Kenneth Arrow’s learning-by-doing theory\(^9\)) and hence increased exports driven by undervaluation allow for increased productivity gains and subsequently, higher growth. Further, this model makes explicit the mechanism through which undervaluation is achieved, namely the accumulation of foreign reserves.

In the model, labor and capital are used to produce two intermediate goods, tradables (T) and nontradables (N). The two intermediate goods can be combined to yield a final good (Z) which the authors assume cannot be traded. A representative consumer-worker maximizes the present value of his utility represented by a constant relative risk averse (CRRA) period utility function with an inter-temporal elasticity of substitution \(1/\theta\). His supply of labor is assumed to be perfectly inelastic, and hence supplies one unit of labor per period (L=1) at all market wages (w). He can rent out his capital, both physical and human, in return for a rental rate (R). Capital is subject to depreciation, at the rate \(\vartheta\). Hence the optimization problem is the following:

\[
\max U = \max \sum_t \beta_t \left( \frac{c_t^{1-\theta}}{1-\theta} \right) \\
\text{s. t. } C + I = w + RK \\
K_{t+1} = (1 - \vartheta)K_t + I \\
\lim_{t \to \infty} (1 + R - \vartheta)^{-t}K_t = 0
\]

Using the Euler equation, a consumption growth rate (\(\gamma^{DE}\)) can be calculated as (see appendix A1):

\[
\frac{c_t}{c_{t-1}} = [\beta(1 + R_t - \vartheta)]^{\frac{1}{\theta}} = 1 + \gamma^{DE} \\
\gamma^{DE} = [\beta(1 + R_t - \vartheta)]^{\frac{1}{\theta}} - 1
\]

\(^9\) Arrow (1962)
**Intermediate goods sector**

The ratio of the prices of tradables \((p_T)\) to nontradables \((p_N)\) intermediate goods in the domestic economy determines the real exchange rate \((q)\). In other words, an appreciation decreases \(q\) while an appreciation increases it. The two sectors hire capital and labor using a Cobb-Douglas function with labor-augmenting technology \(A\) and maximize profit:

\[
\max_{K_T L_T} p_T K_T^\alpha (A_T L_T)^{1-\alpha} - R K_T - w L_T
\]

(5.3)

\[
\max_{K_N L_N} p_N K_N^\eta (A_N L_N)^{1-\eta} - R K_N - w L_N
\]

(5.4)

The authors make the assumption that production in the tradable sector is more capital intensive, hence \((\alpha > \eta)\). Their assumption seems accurate as the literature tends to show that exporting firms use both more sophisticated machinery and have more skilled workers than their domestically-oriented counterparts (see chapter two).

The first-order conditions for the representative firms can be expressed in terms of product rent and product wage:

\[
\alpha K_T^{\alpha-1} (A_T L_T)^{1-\alpha} = R/p_T
\]

(5.5)

\[
(1 - \alpha)K_T^\alpha A_T^{1-\alpha} L_T^{-\alpha} = w/p_T
\]

(5.6)

\[
\eta K_N^{\eta-1} (A_N L_N)^{1-\eta} = R/p_N
\]

(5.7)

\[
(1 - \eta)K_N^\eta A_N^{1-\eta} L_N^{-\eta} = w/p_N
\]

(5.8)

Dividing the first order condition on capital of the nontradable firm (5.5) by the tradable firm (5.7), yields the equilibrium condition for the capital market (5.9). Similarly, dividing the first order conditions on labor will yield the equilibrium for the labor market (5.10):

\[
q = \frac{p_T}{p_N} = \frac{\eta K_N^{\eta-1} (A_N L_N)^{1-\eta}}{\alpha K_T^{\alpha-1} (A_T L_T)^{1-\alpha}}
\]

(5.9)

\[
q = \frac{p_T}{p_N} = \frac{(1-\eta)K_N^\eta A_N^{1-\eta} L_N^{-\eta}}{1-\alpha K_T^\alpha A_T^{1-\alpha} L_T^{-\alpha}}
\]

(5.10)
The equation for labor market equilibrium shows that the real exchange rate \( q \) increases the more productive labor is in the non-tradable sector compared to the tradable sector.

**Final goods sector**

These intermediate goods are assembled into a final good \( Z \) using a Cobb-Douglas production function with share \( \Phi \) of tradable goods and \( (1-\Phi) \) of nontradables.

\[
Z = F_Z(T, N) = A_Z T^\Phi N^{1+\Phi}
\]

\[
\max_{T,N} A_Z T^\Phi N^{1+\Phi} - p_T T - p_N N
\]

Firms will use inputs in proportion to their relative price, i.e.:

\[
q = \frac{p_T}{p_N} = \frac{\Phi}{1-\Phi} \left( \frac{N}{T} \right)
\]

The relative scarcity of tradable goods to non-tradable goods (i.e. \( \Phi \)) is reflected in a depreciation of the real exchange rate. In other words, if \( \Phi \) decreases, \( q \) increases.

**Equilibrium**

Combining the optimality conditions of firms and consumer, one can find the decentralized equilibrium. Assuming the standard market clearing conditions of the labor and capital markets:

\[
K_T + K_N = K
\]

\[
L_T + L_N = L = 1
\]

And that the entire supply of intermediate goods is used for the production of the final good. Hence, in this case the authors make the simplifying assumption that the current account is balanced.

\[
N = F_N(K_N, L_N)
\]

\[
T = F_T(K_T, L_T)
\]
Substituting the above production functions into the earlier optimality condition (5.9), the result is:

\[ q = \frac{p_T}{p_N} = \frac{\phi}{1-\phi} \left( \frac{N}{T} \right) = \frac{\phi}{1-\phi} \cdot \frac{K_T^N/(A_N L_N)^{1-\eta}}{K_T^G/(A_T L_T)^{1-\alpha}} \]  
(5.18)

Adding definitions for the capital ratio (\( \kappa \)) and labor ratio (\( \lambda \)) as the ratio of each input in the nontradable sector to the tradable sector:

\[ \kappa = K_N/K_T, \ \lambda = L_N/L_T \]  
(5.19)

Rewriting, we can obtain the sectoral allocations for given ratios (as illustrated for \( K_T \))

\[ K_T = \left( \frac{K_T}{K_T + K_N} \right) K = \left( \frac{K_T/K_T}{K_T/K_T + K_N/K_T} \right) K = \left( \frac{1}{1+\kappa} \right) K, \quad K_N = \left( \frac{\kappa}{1+\kappa} \right) K \]  
(5.20)

\[ L_T = \left( \frac{1}{1+\lambda} \right) L, \quad L_N = \left( \frac{\lambda}{1+\lambda} \right) L \]  
(5.21)

Dividing the optimality conditions for the capital (5.9) and labor (5.10) markets by that for the goods market respectively, one can obtain the optimal capital (\( \kappa^* \)) and labor ratios (\( \lambda^* \)) (see appendix A2 for algebra)

\[ \kappa^* = \frac{1-\phi}{\phi} \cdot \left( \frac{\eta}{\alpha} \right) \]  
(5.22)

\[ \lambda^* = \frac{1-\phi}{\phi} \cdot \left( \frac{1-\eta}{1-\alpha} \right) \]  
(5.23)

Note: Given the earlier assumption that the tradable sector is more capital intensive, it follows that \( \lambda^* > \kappa^* \).

A consolidated final goods production can be obtained given the assumption that the aggregate level of productivity in the intermediate goods sector is endogenous and rises approximately in proportion with the aggregate capital stock:

\[ \Delta A_T \approx \Delta A_N \approx \Delta K \]  
(5.24)
In other words, investment creates positive externalities for the economy as a whole through spillovers into technological advancement (learning-by-investing). Normalizing the units of \( T \) and \( N \), then

\[
A_T = A_N = K \quad (5.25)
\]

Given this assumption of the endogeneity of technology, the sectoral factor allocations (5.20 and 5.21) and the previously introduced final goods production function (5.11), one can assemble a consolidated final goods production function for any pair of capital and labor ratios:

\[
F_Z(T, N) = A(\kappa, \lambda) K \quad (5.26)
\]

\[
A(\kappa, \lambda) = \frac{F_Z(T, N)}{K} = \left( A_Z [K_T^\phi (KL_T)^{1-\alpha}] \phi [K_N^\eta (KL_N)^{1-\eta}]^{1-\phi} \right) / K
\]

\[
= A_Z \left[ \left( \frac{1}{1+\kappa} \right)^\alpha \left( \frac{1}{1+\lambda} \right)^{1-\alpha} \right]^{1-\phi} \left[ \left( \frac{\kappa}{(1+\kappa)} \right)^\eta \left( \frac{\lambda}{1+\lambda} \right)^{1-\eta} \right]^{1-\phi} L^{1-\alpha} \quad (5.27)
\]

Note: \( \bar{\alpha} \) is the weighted average capital share in the economy: \( \bar{\alpha} = \alpha \phi + \eta (1 - \phi) \)

It is interesting now to compare the returns on capital of the individual agent and society as a whole given the technological spillovers from aggregate investment. In the decentralized equilibrium, the private return on capital is equal to the marginal product of capital in the intermediate goods sectors. Substituting \( p_T = \phi (\frac{N}{T})^{1-\phi} \), we can solve for the private return on capital:

\[
R = \alpha p_T K_T^{\alpha-1} (A_T L_T)^{1-\alpha} = \alpha \phi A_Z T^\phi N^{1-\phi} K_T
\]

\[
= \frac{\alpha \phi}{K} A_Z T^\phi N^{1-\phi} = \frac{\alpha \phi (1+\kappa^*)}{K} = \bar{\alpha} A^* \quad (5.28)
\]

Here \( A^* \) is the decentralized equilibrium with \( A^* = A(\kappa^*, \lambda^*) \). The individual agent captures only a share (\( \bar{\alpha} \)) of the social return of investment and his investment creates a positive spill-over of \( (1 - \bar{\alpha}) \) for the society. Given the private return, the decentralized agent chooses a level of investment that allows for the optimal growth rate given by the Euler equation.
Moving from a decentralized equilibrium to a centralized equilibrium (i.e. the economy is directed by an omniscient social planner), the agent now internalizes the investment externality. The return is not only the private return (5.28), but also the higher wage income due to the increase in technology. This gives the social planner’s Euler equation:

$$\frac{c_t}{c_{t-1}} = \left[ \beta (1 + A^* - \delta) \right]^{\frac{1}{\delta}} = 1 + \gamma^{SP} \tag{5.29}$$

Given $A^* > R$, the growth rate of the social planner ($\gamma^{SP}$) and subsequently level of investment will be higher than that of the decentralized agent. With decentralization, the equilibrium will lead to slower growth and hence the authors argue this “creates a natural case for policy intervention.”

**Steady state**

According to the AK model on which this model is predicated, there exists a steady state in which the interest rate will not vary and the capital stock, output and consumption will grow at a constant rate ($\gamma^{DE}$ in the decentralized equilibrium and $\gamma^{SP}$ in the social planner’s equilibrium). In both equilibrium, the social return on capital is $\gamma = A^*$. Investment ($I$) must grow at a rate just large enough to cover both the growth rate of output and the depreciation of the capital stock. Output (simply the product of the capital stock and given social return) less investment will yield the consumption equation.

$$I = (\gamma + \delta)K \tag{5.30}$$

$$C = AK - I = (A - \gamma - \delta)K \tag{5.31}$$

Looking at the welfare effects, we can plug in the values of capital and consumption at a given time to calculate the welfare as given by the representative consumer utility function:

$$K_t = (1 + \gamma)^t K_0 \text{ and } C_t = (A - \gamma - \delta)(1 + \gamma)^t K_0$$

---

92 Korinek and Serven (2010), p.12
Figure 3 represents graphically the utility curves derived from the above equation. The red lines show the growth rates that decentralized agents and social planners would choose for a given productivity level ($A$) as determined by the Euler equations. The optimal growth rate is $\gamma^{sp}$ as this provides the maximum inter-period utility. Increasing the growth rate from any rate below this level will increase welfare, while going above this rate will reduce welfare as it will sacrifice too much current consumption. The equilibria for each scenario are represented by the intersection of the respective utility function and Euler-derived growth line.

**Figure 3: Iso-utility curves in ($A$, $\gamma$) space**

\[
U(\gamma, A) = \sum \beta^t \left( \frac{C^{1-\theta}}{(1-\theta)} \right) = \sum \beta^t \left[ \frac{(A - \gamma - \delta)(1 + \gamma)^tK_0}{1-\theta} \right]^{1-\theta} = \frac{1}{1-\theta} \left[ \frac{(A - \gamma - \delta)K_0}{1 - \beta(1+\gamma)^{1-\theta}} \right]^{1-\theta}
\] (5.32)
Targeting Problem

The level of investment produced by the decentralized agent will be suboptimal (i.e. too low) given that he does not internalize the social returns to capital. The solution is to design a policy tool which can reduce this “wedge” between private and social returns (i.e. capture the externalities from investing). A subsidy on holding capital, an investment tax credit and a subsidy on production could all theoretically increase the incentive to invest and close the wedge.

However, these tools require the government to have very precise information about the economic actors and their investment decisions as well the institutional capacity to implement any such investment policies. Agency problems would inevitably be rife. A general investment subsidy would encourage some actors to invest in wasteful projects. A more targeted subsidy would also be difficult, especially in a developing country scenario, as this would result in the government essentially picking winners and the process would likely be subject to robust rent-seeking and corruption constraints. These considerations are parallel to those highlighted by the Rodrik model.

Korinek and Serven present two possible solutions to this targeting problem. First, the government could make up for the low level of private investment by increasing the level of public investment (i.e. making capital available to the private sector at the prevailing market rate). At first glance, it seems reasonable this could raise the level of investment and hence the growth rate given by the Euler equation. However, such public investment would simply crowd out private investment: for every euro increase in the government capital stock, the private agent would simply reduce their investment by the same amount as he is still bound by the same optimization problem. In other words, an increase in public investment would fully crowd out private investment. Further, if such an initiative were financed by distortionary taxes this could actually lead to even less investment than with no intervention.

The second and more attractive solution to this targeting problem is exchange rate policy. Raising the domestic price of tradables would target only the more capital-intensive, tradable sector. Moreover, private agents would only invest in projects they
estimated profitable as they must compete to meet foreign demand, eliminating (at least in part) the distorted incentives outlined earlier. This rise in the exchange rate would be carried out through the accumulation of foreign reserves. Korinek and Serven write “by accumulating foreign reserves governments can ‘outsource’ these targeting problems to foreigners.”

**Foreign Reserve Accumulation**

In an economy with closed capital accounts private agents cannot participate in the international financial markets (i.e. lend or borrow abroad). With such restrictions, the accumulation of foreign reserves acts like a loan which finances the purchase of domestic tradables by foreign agents. Accumulation drives down the value of the currency as the demand for domestic tradables increases while the demand for foreign tradables does not. This is very much like the situation in China discussed earlier.

The depreciated exchange rate increases the profitability of the tradable sector, and given its relative capital-intensiveness, more investment will follow the increased returns to capital in this sector and the aggregate investment level will move closer to the social optimal. Suppose the government intervenes and accumulates a fraction \( \nu \) of domestic tradables, the equilibrium condition for the final goods sector is then reduced by \( (1 - \nu) \). The optimal ratios of capital and labor in the intermediate goods sectors are therefore:

\[
\kappa(\nu) = (1 - \nu)\kappa, \quad \lambda(\nu) = (1 - \nu)\lambda
\]  

(5.33)

In equilibrium, the price of tradables in the economy is now:

\[
p_T(\nu) = \phi A_Z \left( \frac{F_N(\cdot)}{(1-\nu)F_T(\cdot)} \right)^{1-\phi}
\]  

(5.34)

---

Korinek and Serven (2010), p. 18
And the equilibrium interest rate is (modifying equation 6):

\[ R(v) = \alpha p_T \frac{F_T(\cdot)}{K_T} = \frac{\alpha f A_T}{(1 - v)^{1-\phi}} \left( F_T(\cdot) \phi F_N(\cdot) \right)^{1-\phi} \]

\[ = \frac{\alpha f^{(1-u)}(1-\phi)}{(1-v)^{1-\phi}} A(\kappa(v), \lambda(v)) \] (5.35)

The welfare effects of the foreign reserve accumulation depend on weighing the benefits derived from the increased investment against the costs of the foregone tradable goods that could otherwise have been consumed by the representative agent. Figure 4 shows graphically the welfare gains. The slope of the representative agent’s indifference curve in the decentralized equilibrium can be estimated by differentiating the agent’s welfare function for constant utility (\( \bar{U} \)):

\[ \frac{dy}{dA \bar{U}} = \frac{-1-\beta(1+\gamma)^{1-\theta}}{\beta(1+\delta) \theta(1+\gamma)^{-\theta}-1} \] (5.36)

The output/growth trade-off of the intervention is captured by the slope of the VV locus:

\[ \frac{dy}{dA V(v)} \bigg|_{v=0} = \frac{dy/dv}{dA V(v)/dv} \bigg|_{v=0} = \frac{\beta \gamma (1-\phi) (\bar{a}-\eta)}{\phi \theta (1+R-\delta)^{1-\theta}/\theta} \] (5.37)
Figure 4: Effects of Current Account Intervention

Source: Korinek and Serven (2010). p. 19

More specifically, the dynamic welfare gains from foreign currency intervention depend on a number of key parameters of the economy. Table 4 presents the authors’ calculations with different assumptions about the share of tradables in the economy ($\phi$), capital share in each intermediate goods sector ($\alpha, \eta$), the patience of the agent (time-discount rate $\beta$) and the elasticity of substitution ($\theta$). $MU_{r(v)}$ is the marginal utility gain from the increase in growth rate resulting from an intervention $v^*$, while $MU_{A(v)}$ is the marginal utility loss resulting from the reduction in consumption. Where the net marginal utility gain is positive, the last column of the table lists the optimal size of the intervention (otherwise a net loss is denoted by - and the optimal intervention is zero).
Table 4: Optimal Reserve Accumulation for Selected Parameter Values

<table>
<thead>
<tr>
<th>Benchmark Economy</th>
<th>( \phi )</th>
<th>( \alpha )</th>
<th>( \eta )</th>
<th>( A^* )</th>
<th>( \beta )</th>
<th>( \theta )</th>
<th>( \bar{\alpha} )</th>
<th>( \gamma^{DE} )</th>
<th>( MU_{P(v)} )</th>
<th>( MU_{A(v)} )</th>
<th>( \nu^* )</th>
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</thead>
<tbody>
<tr>
<td>B1</td>
<td>0.4</td>
<td>0.8</td>
<td>0.3</td>
<td>0.4</td>
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<td>1</td>
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<td>22.08</td>
<td>-16.34</td>
<td>0.28</td>
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<td>0.6</td>
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<td>0.4</td>
<td>0.3</td>
<td>0.4</td>
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<td>1</td>
<td>0.34</td>
<td>14%</td>
<td>4.93</td>
<td>-13.06</td>
<td>-</td>
</tr>
<tr>
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<td>0.4</td>
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</tr>
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<td>0.4</td>
<td>0.4</td>
<td>0.3</td>
<td>0.4</td>
<td>0.96</td>
<td>2</td>
<td>0.34</td>
<td>0.7%</td>
<td>5.39</td>
<td>-35.06</td>
<td>-</td>
</tr>
<tr>
<td>LES4</td>
<td>0.4</td>
<td>0.9</td>
<td>0.5</td>
<td>0.4</td>
<td>0.96</td>
<td>2</td>
<td>0.66</td>
<td>6.6%</td>
<td>3.11</td>
<td>-24.94</td>
<td>-</td>
</tr>
<tr>
<td>LES5</td>
<td>0.4</td>
<td>0.5</td>
<td>0.2</td>
<td>0.4</td>
<td>0.96</td>
<td>2</td>
<td>0.32</td>
<td>0.3%</td>
<td>19.34</td>
<td>-37.12</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Korinek and Serven (2010). p. 21

In the benchmark case, there are net gains from intervention in the two scenarios (B1 and B5) which have low overall capital shares, but with the tradable sector being significantly more capital intensive. The authors argue that the low aggregate capital share implies large learning-by-investing externalities, while the large difference in capital intensities suggests that the currency market intervention has a significant effect on the returns to capital in the tradable sector (i.e. there is a Stolper-Samuelson effect\(^{94}\)).

In the case of a relatively closed economy (the share of tradables is 0.2) there are three scenarios with net gains, as smaller interventions are necessary to affect the real exchange rate. With a more patient representative agent, intervention will also yield higher net gains as he will be more willing to give up present consumption for growth in future consumption. With such an agent, intervention is desirable in the same scenarios as in the benchmark case. In the fourth case of an economy with lower inter-temporal

\(^{94}\) The Stolper-Samuelson theory states that an increase in the relative price of a good will lead to an increase in the return to the factor which is used most intensively in the production (e.g. capital) and a decrease in the other (e.g. labor).
elasticity of substitution, it is largely the opposite case: as the agent values present consumption significantly more than future consumption, he will not be willing to give up present consumption to secure higher future growth; hence intervention only yields net utility losses.

It is important to note that the calculations have assumed the intervention to be a loss of resources, but this is a somewhat extreme assumption. The accumulation of foreign reserves can act as an important insurance mechanism which brings significant additional benefits. Moreover, these reserves can be “cashed in” for imports in the future once the country has experienced significant technological development and the learning-by-investing externalities approach zero, and hence are not a loss per se.

The model so far has assumed the capital account to be closed, while in practice, most developing countries allow differing levels of capital inflows and outflows. With capital mobility, capital will chase the highest interest rate: if the world market interest rate ($r^W$) is higher than the domestic rate, the agent has the incentive to lend abroad by exporting tradable intermediate goods. As the quantity of tradable goods in the economy shrinks, this will raise the return to capital in the sector.

Let us examine the case where the social return on capital is greater than the world market rate, but private returns are lower (i.e. $A^* - \delta > r^W > \alpha A^* - \delta$). The agent would export capital given he does not capture the learning-by-investing externality, resulting in less investment and a socially inefficient outcome. This makes a cogent case for capital controls in a developing economy.

Similarly, looking at the effects of an exogenous inflow of foreign currency, stemming from natural resource revenues or foreign aid receipts, shows such flows can have serious welfare implications. The economy will experience a static welfare improvement as a result of the increased available resources, but this will entail an even greater dynamic loss as the increased supply of tradable intermediate goods pushes down returns to capital in the sector, reducing investment and growth. Korinek and Serven emphasize that what matters for this outcome is not the capital intensity of the natural resources, but the capital intensity of those tradable goods that were previously
produced domestically, but subsequently imported after the discovery of the natural resources. They conclude that a “small exogenous inflow of tradable resources unambiguously reduces welfare.” In the development literature, this is often referred to as the “resource” or “aid curse.”

6. Undervaluation: Relevance in the African context

“It is wishful thinking to imagine that the export of manufactures [in Africa] is ever going to start without the benefit of a highly competitive real exchange rate.”

- John Williamson 96

6.1. Money in Africa: Overview of exchange rate regimes, past and present

The exchange rate regimes in Africa have moved over the decades with broader historical events. With the increasing European presence on the continent beginning in the 17th and 18th centuries, the colonial powers replaced indigenous currencies, such as cowry shells and silver coins, with metropolitan-issued coins and notes tied to the given European currency. At the time, European currencies were linked to gold; hence the new currencies were linked through this mechanism to the gold standard.97 Different countries had different monetary institutions, with the prominence of national currency boards in the British colonies and a regional monetary union in the French.

Following the end of the colonial period, only the French sought to maintain monetary ties, with the French Treasury continuing to guarantee the convertibility of the CFA Franc (Communauté Financière d'Afrique) to French francs. The other former colonial powers, namely Britain, broke off these arrangements, and the newly independent countries created their own currencies and central banks.

The CFA zone lives on today, made up of 12 former French colonies together with Equatorial Guinea and Guinea-Bissau. The 14 member states are split into two theoretically separate currency zones (the West African CFA Franc and the Central African CFA Franc) each with a separate central bank, though the currencies are effectively interchangeable and are pegged to the Euro at the same rate guaranteed by the Banque de France.

A monetary union exists also in Southern Africa. The Multilateral Monetary Area links South Africa with the tiny in-land states of Lesotho and Swaziland, as well as Namibia.

96 Williamson (1997). p.30
97 Masson and Pattillo (2005. p.18
Besides these monetary areas with fixed exchange rates, many African countries have followed the broader global trend towards floating exchange rates. In 2011, the IMF classified 11 countries as having floating exchange rates (see table 5).

Table 5: Exchange Rate Regimes in Africa (as of April 2011)

<table>
<thead>
<tr>
<th>Floating (11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gambia, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Sierra Leone, Somalia, South Africa, Tanzania, Uganda, Zambia</td>
</tr>
<tr>
<td>Other Managed Float (5)</td>
</tr>
<tr>
<td>Angola, Guinea, Liberia, Mauritania, Nigeria, Sudan</td>
</tr>
<tr>
<td>Crawling (3)</td>
</tr>
<tr>
<td>Botswana, Ethiopia, Rwanda</td>
</tr>
<tr>
<td>Peg (22)</td>
</tr>
<tr>
<td>No separate legal tender (1)</td>
</tr>
<tr>
<td>Zimbabwe</td>
</tr>
</tbody>
</table>

Source: Compiled from IMF Annual Report on Exchange Arrangements and Exchange Restrictions 2011

As well as shifting exchange rate regimes, African economies have largely moved away (albeit slowly) from the heavily overvalued currencies pervasive in the 1970’s and 80’s. The political arrangements in many African countries favored overvalued currencies in order to supply the elite and urban populations with cheaper imported goods at the expense of mostly rural agricultural exporters. This practice became unsustainable with increasing debt levels and the sharp fall in commodity prices which many African economies depend on for foreign exchange.

World Bank and IMF structural adjustment programs pushed an agenda of devaluation, though African currencies were on average much slower to adjust than other developing world currencies. Elbadawi et al. (2009) find that the median developing country real exchange rate adjusted 30% in six years, while it took the median African country almost twice as long. The authors argue that this delay was costly for Africa: “The fact that the median African country had lagged behind on this key aspect of economic reform must be associated with the disappointing export and growth performance of
Africa relative to the rest of the developing world.” 98 Earlier work by Easterly and Levine (1995) find that Africa’s overvalued currencies (proxied by black market premiums) cost the continent’s economies 0.4 to 2.3 percentage points of annual per capita income growth compared to the rest of the world. 99

The structural adjustment programs also resulted in significant shifts in central banking across Africa. Central banks gained increased independence from the government, allowing monetary policy to resist political demands and focus more on price-stabilization. Interest-rate ceilings were lifted and the commercial banking sector was in large part liberalized. 100 Summarizing the state of central banking on the continent today, Ajakaiye and O’Connell (2011) write: “the majority of countries now operate reserve-money frameworks that target a broad money aggregate and sharply limit domestic lending to government.” 101 Understanding this evolution will be essential to examining the policy tools available to central banks in pursuing exchange rate objectives.

How competitive are Africa’s currencies today? Under its mandate to oversee the international monetary system, the IMF keeps close tabs on the macroeconomic fundamentals of its 187 member countries, including exchange rates. The IMF routinely undertakes macro diagnostics known as Article IV Consultations in cooperation with member country governments and makes these available to the public. These diagnostics include assessments of the level of the country’s currency, using the methods outlined in section three. Table 6 presents the Fund’s estimates of the real exchange rate alignments for African economies compiled from the most recent Article IV Consultation available for the given economy.

These estimates show that African currencies are generally aligned with their estimated equilibrium rates, though the majority exhibit slight overvaluation. Indeed, only Uganda appears to be undervalued to any significant degree.

98 Elbadawi et al. (2009), p. 7
100 Ajakaiye and O’Connell (2011), p.i4
101 Ajakaiye and O’Connell (2011), p.i5
<table>
<thead>
<tr>
<th>Country</th>
<th>(Year)</th>
<th>Macroeconomic balance</th>
<th>ERER</th>
<th>External Sustainability</th>
<th>PPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola</td>
<td>(2007)</td>
<td>roughly at equilibrium, no specific calculations provided in Article IV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benin</td>
<td>(2010)</td>
<td>overvalued by 13 to 22% (not broken down by specific method)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Botswana</td>
<td>(2011)</td>
<td>4 to 6%</td>
<td>9%</td>
<td>11%</td>
<td>8%</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>(2009)</td>
<td>close to equilibrium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burundi</td>
<td>(2010)</td>
<td>-</td>
<td>6%</td>
<td>“modestly overvalued”</td>
<td></td>
</tr>
<tr>
<td>Cameroon</td>
<td>(2011)</td>
<td>15%</td>
<td>-13%</td>
<td>13%</td>
<td>-</td>
</tr>
<tr>
<td>Cape Verde</td>
<td>(2010)</td>
<td>9%</td>
<td>-13%</td>
<td>6%</td>
<td>-</td>
</tr>
<tr>
<td>CAR</td>
<td>(2010)</td>
<td>appropriately valued</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chad</td>
<td>(2011)</td>
<td>REER broadly in line with fundamentals though non-oil REER overvalued by 15%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comoros</td>
<td>(2011)</td>
<td>2%</td>
<td>8%</td>
<td>22%</td>
<td>10%</td>
</tr>
<tr>
<td>Congo</td>
<td>(2010)</td>
<td>REER broadly in line with fundamentals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congo, D.R.</td>
<td>(2009)</td>
<td>No significant misalignment (though limited data quality)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eritrea</td>
<td></td>
<td>No assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethiopia</td>
<td>(2010)</td>
<td>10%</td>
<td>7%</td>
<td>equilibrium</td>
<td>-</td>
</tr>
<tr>
<td>Gabon</td>
<td>(2010)</td>
<td>broadly in line with fundamentals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gambia</td>
<td>(2010)</td>
<td>11%</td>
<td>5 to 7%</td>
<td>8 to 11%</td>
<td></td>
</tr>
<tr>
<td>Ghana</td>
<td>(2011)</td>
<td>2 to 5%</td>
<td>-</td>
<td>2 to 5%</td>
<td>-</td>
</tr>
<tr>
<td>Guinea</td>
<td>(2007)</td>
<td>relative equilibrium and reflects changes in fundamentals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>(2010)</td>
<td>-3%</td>
<td>-</td>
<td>-3%</td>
<td>-</td>
</tr>
<tr>
<td>Kenya</td>
<td>(2009)</td>
<td>-</td>
<td>-3%</td>
<td>-6%</td>
<td>-</td>
</tr>
<tr>
<td>Lesotho</td>
<td>(2008)</td>
<td>overvaluation of 5 to 11% (though must be read with caution)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liberia</td>
<td>(2010)</td>
<td>12 to 15%</td>
<td>-</td>
<td>8%</td>
<td>-</td>
</tr>
<tr>
<td>Madagascar</td>
<td>(2007)</td>
<td>broadly in line with macroeconomic fundamentals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malawi</td>
<td>(2009)</td>
<td>14%</td>
<td>5%</td>
<td>18%</td>
<td>-</td>
</tr>
<tr>
<td>Mali</td>
<td>(2010)</td>
<td>8 to 16%</td>
<td>-</td>
<td>9%</td>
<td>-</td>
</tr>
<tr>
<td>Mauritania</td>
<td>(2009)</td>
<td>3%</td>
<td>11%</td>
<td>7%</td>
<td>-</td>
</tr>
<tr>
<td>Mauritius</td>
<td>(2011)</td>
<td>12%</td>
<td>8%</td>
<td>12%</td>
<td>-</td>
</tr>
<tr>
<td>Mozambique</td>
<td>(2011)</td>
<td>0.5%</td>
<td>-4%</td>
<td>-1%</td>
<td>-</td>
</tr>
<tr>
<td>Namibia</td>
<td>(2010)</td>
<td>6%</td>
<td>2%</td>
<td>5%</td>
<td>-</td>
</tr>
<tr>
<td>Niger</td>
<td>(2011)</td>
<td>2%</td>
<td>-6%</td>
<td>6%</td>
<td>-</td>
</tr>
<tr>
<td>Nigeria</td>
<td>(2010)</td>
<td>14%</td>
<td>2%</td>
<td>15%</td>
<td>-</td>
</tr>
<tr>
<td>Rwanda</td>
<td>(2010)</td>
<td>-3%</td>
<td>-1%</td>
<td>-11%</td>
<td>-</td>
</tr>
<tr>
<td>Sao Tome</td>
<td>(2003)</td>
<td>broadly in line with fundamentals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senegal</td>
<td>(2010)</td>
<td>5%</td>
<td>equilibrium</td>
<td>8%</td>
<td>-</td>
</tr>
<tr>
<td>Seychelles</td>
<td>(2010)</td>
<td>1 to 11%</td>
<td>-7 to -11%</td>
<td>equilibrium</td>
<td>-</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>(2010)</td>
<td>equilibrium</td>
<td>1%</td>
<td>3%</td>
<td>-</td>
</tr>
<tr>
<td>Somalia</td>
<td></td>
<td>no Article IV assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>(2011)</td>
<td>14%</td>
<td>20%</td>
<td>equilibrium</td>
<td>-</td>
</tr>
<tr>
<td>Sudan</td>
<td>(2010)</td>
<td>estimated to be near equilibrium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Sudan</td>
<td></td>
<td>no Article IV assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swaziland</td>
<td>(2010)</td>
<td>18%</td>
<td>20 to 25%</td>
<td>16%</td>
<td>-</td>
</tr>
<tr>
<td>Tanzania</td>
<td>(2011)</td>
<td>3%</td>
<td>4%</td>
<td>7%</td>
<td>-</td>
</tr>
<tr>
<td>Togo</td>
<td>(2011)</td>
<td>2%</td>
<td>-3%</td>
<td>2%</td>
<td>-</td>
</tr>
<tr>
<td>Uganda</td>
<td>(2008)</td>
<td>-9%</td>
<td>-</td>
<td>-4 to -27%</td>
<td>-</td>
</tr>
<tr>
<td>Zambia</td>
<td>(2009)</td>
<td>9%</td>
<td>17%</td>
<td>-15%</td>
<td>-</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>(2011)</td>
<td>dollarized, no separate national currency</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Compiled from IMF Article IV Consultations
Looking at the volatility of exchange rates, African currencies experienced extended periods of high volatility in the 1980’s and early 1990’s, with a significant move towards more stability beginning in the late 1990’s. However, the recent financial crisis has again brought increased exchange rate volatility to the region, with significant increases in volatility in many key currencies (see figure 5).

**Figure 5: Exchange Rate Volatility for Select African Currencies**

![Exchange Rate Volatility Graph](source: Ben Ltaifa et al. (2009), p. 6)

6.2. Going under: Examining the prospects for undervaluation for Africa

The premise of the Rodrik model presented in chapter four is that the tradable sector is more subject to market imperfections such as a weak contracting environment than the nontradable sector. Given exporting firms tend to be relatively larger than their nontradable counterparts (which includes the vast majority of informal sector firms), this premise seems quite reasonable for the African context. Further, given the need of exporters to negotiate through a myriad of customs, infrastructure and other institutional obstacles (as discussed in chapter two), it seems there is a cogent case for such an intervention in theory.

Haddad and Pancaro (2010) point out that most developing countries manage their currencies to one degree or another and that exchange rates are largely driven by

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102 Clark et al. 2004, p. 35
economic policies rather than by market fluctuations. If African policymakers decided to follow the route of explicit currency undervaluation, how would they go about it?

The primary tool for currency undervaluation is the accumulation of foreign reserves. As highlighted earlier in the case of China, a central bank can pursue targeted interventions in the foreign exchange markets, actively purchasing foreign currencies and holding them as reserves. Again, this makes the tradable sector more competitive and drives investment to the sector. The findings of the Korinek-Serven model point to foreign reserve accumulation as having net welfare gains for economies with a) relatively low capital shares, but with the tradable sector being significantly more capital-intensive, b) lower levels of trade and c) higher patience (i.e. lower inter-temporal elasticity of demand).

Do African economies fit such optimal parameters? Kalemli-Ozcan and Sorenson (2011) use firm-level data from a large sample of African firms from across the continent to calculate the capital-labor ratio. They find the average ratio to be less than half of the German average, indicating that on average, African firms are much less capital intensive than their developed country counterparts. Interestingly, the variance in the capital-labor ratios is much higher among African firms, illustrating the relative firm heterogeneity discussed in chapter two.103

Looking at differences within sectors, Arellano et al (2009) argue that the capital share in the tradable sector is actually significantly lower than in the nontradable sector. Using Cote d’Ivoire as a benchmark, the authors calculate a capital share of 0.3 for the tradable sector compared to 0.5 for the nontradable sector. Their premise is that low-income countries tend to export labor-intensive goods, mainly agricultural commodities for the case of Africa, while nontradable infrastructure projects are very capital-intensive.104 Unfortunately, data on the tradable sectors of other countries is not available and hence it is difficult to conclude whether this parameter is a reliable estimate for the continent as a whole. Indeed, it seems difficult to imagine one country-specific estimate can be generalized for such a diverse continent and many countries with more manufacturing-based economies may have significantly different capital

103 Kalemli-Ozcan and Sorenson (2011), p.22
104 Arellano et al (2009), p.89
share ratios, hence making foreign exchange accumulation more attractive. What is clear is that economies which begin to move up the value chain in terms of exports (e.g. from unrefined agricultural commodities to light manufacturing/processing) will begin to see an increasing capital share in the tradable sector and hence increasing returns to foreign reserve accumulation.

In terms of the trade parameter, Africa is relatively open to trade, hence making the foreign reserve accumulation less attractive. According to aggregated World Bank data, trade (defined as exports plus imports) equaled 62% of Africa’s GDP in 2010, compared to 70% in the developing East Asian economies and 50% for OECD countries. As for “patience”, this is relatively difficult to quantify in the real world, but given the low level of savings compared to consumption in Africa, it may be difficult to satisfy this parameter as well.

Purchasing reserves can be costly, especially for cash-strapped African governments. As the Korinek-Serven model illustrates, the more open an economy is, the larger the intervention would need to be. Restrictions on capital mobility can have similar effects on the exchange rate without the need to accumulate large reserves. Placing limits on capital inflows, while encouraging capital outflows would have similar supply and demand effects on the currency as foreign reserve accumulation. However, as the Korinek-Serven model illustrates, allowing capital to flow out of the country would reduce investment.

Further, many countries receive and will continue to receive large inflows of foreign money, either through aid (in 2009, 21 African countries received aid equivalent to 10% or more of their GDP) or more importantly, from natural resource exports. Such inflows will put upward pressure on the domestic currency; resulting in potential “Dutch disease” effects (i.e. currency appreciation makes all other export sectors uncompetitive as exemplified by the Dutch discovery of natural gas in the 1970’s).

Using within-country variations, Rajan and Subramanian (2011) find that aid reduces the size of the tradable sector through the proximate transmission mechanism of

exchange rate appreciation. Specifically, they observe that in countries with higher aid receipts, the export-oriented manufacturing industries grow more slowly than those which are typically more domestically-oriented.\textsuperscript{107} Further, the effects of aid inflows on spurring investment are not clear. Many studies (e.g. Easterly (1999), Rajan and Subramanian (2008), Arellano et al (2009)) find that aid has had no effect on investment in Africa, rather simply increasing consumption. Other studies have found a positive correlation with aid and investment (e.g. Hansen and Tarp (2001), Gyimah-Brempong and Racine (2010)).

More important in the medium term will be inflow from oil and mineral exports. Many top-performing African economies, such as Uganda (which currently has a slightly undervalued currency according to the IMF estimates) and Ghana, will see significant new revenue streams from new oil production operations. Indeed, both countries are expected to attain a production level of 50,000 - 150,000 barrels per day within the next five years, generating the potential for national revenues equal to the countries respective GDPs today.\textsuperscript{108} This will put significant upward pressure on the currencies, pushing up the real costs of exports of these countries.

Indeed, many countries already are heavily dependent on natural resources. According to World Bank data, natural resource rents accounted for at least 25% of GDP in ten African economies in 2008.\textsuperscript{109} Sterilizing the impact of these inflows on the currency (i.e. avoiding considerable appreciation) would require the government not to spend these windfalls, but rather put them into reserves. Given the competitive nature of the politics in these democracies (e.g. vs. authoritarian China), this seems like a politically impossible option for leaders.

Nominal devaluation is another available tool, though only for economies that have fixed or crawling exchange rates (see table 5). To illustrate, let us take the example of the CFA zone which currently has its CFA franc pegged to the Euro at a rate of 656 francs per Euro. A devaluation of 20% would increase the exchange rate to 787 francs per Euro. This would make exports from these countries 20% cheaper (and imports 20% more expensive) overnight. However, prices would likely adjust relatively quickly,

\begin{flushright}
\textsuperscript{107} Rajan and Subramanian (2011), p. 108
\textsuperscript{108} Revenue Watch Institute estimates.
\textsuperscript{109} World Bank Databank
\end{flushright}
though the government could counteract this with price and wage moderating policies. Further, given the political considerations (The Banque de France still guarantees the peg to the Euro) a consensus on such a move among the 12 members of the CFA zone could be difficult in practice.

In January 1994, the CFA Franc was devalued by 50% following decades of significant overvaluation.\textsuperscript{110} Van den Boogaerde and Tsangarides (2005) find the devaluation returned the area to positive growth rates and improved the competitiveness of the economies in the currency area, but these positive effects were short-lived due to political instability beginning in the late 1990’s. Investment, for example, increased from 12.5% of GDP in 1990-93 to 16.4% of GDP in 1994-98, spurred by the improvement in the investment climate. However further devaluation does not seem to be likely in the near term: in November 2011, the two central banks issued a joint statement saying no further devaluation is expected for 2012.\textsuperscript{111}

Summa summarum, a strategy of undervaluation à la East Asia appears very difficult in practice for African economies in the current context.

6.3. Beggar-thy-neighbor and long-term considerations

Further, a strategy of undervaluation may have broader economic implications. First, the Korinek-Serven model includes only a single small country trading with the world. Expanding the model to include many countries pursuing this strategy would introduce fundamental dynamics which could significantly dampen the net effects. In the conclusion of their paper, Korinek and Serven hypothesize that in a scenario with multiple countries pursuing reserve accumulation, these actions will result in negative externalities on each other to the benefit of the developed countries (i.e. those not benefitting from learning-by-investing externalities). In other words, more countries competing for the import market of the developed countries could result in a harmful race to the bottom.

\textsuperscript{110} Van den Boogaerde and Tsangarides (2005), p.3
\textsuperscript{111} Reuters Africa, November 28, 2011.
African policymakers must also consider the effects of perceived “currency manipulation” on their preferential trade status. The majority of African countries receive preferential access to important markets through the European Union’s Everything But Arms (EBA) and/or the US’s African Growth and Opportunity Act (AGOA). These agreements bestow significant advantages for African manufactured exports, though cumbersome Rules-of-Origin restrictions among other problems have reduced the impact on export growth. Should African policymakers embark on a strategy of undervaluation, European and American policymakers may push for a withdrawal of these preferences, especially in light of the heated accusations against China’s currency intervention.

Lastly, the long-term effects of undervaluation are not thoroughly understood, and could pose delayed effects to the health of the economy. Capiello and Ferrucci (2008) argue that China’s exchange rate regime “exacts high welfare costs from different sectors of the Chinese economy and poses long-term risks to financial stability.”112 The large-scale intervention by the PBOC (as discussed in chapter three) means large-scale monetary expansion, leading to the potential for over investment and possibly a far more devastating downturn for the domestic economy going forward. The authors admit the Chinese economy still looks relatively healthy, but these imbalances could cause problems in the long term.

112 Capiello and Ferrucci (2008), p.5
7. Conclusion

In the dawn of the independence era of the 1960’s, Africa seemed like the economic rising star, while Asia was mired in widespread poverty, autarky and conflict. Speaking of Ghana, one of the first African countries to gain independence, the historian Martin Meredith writes: “Ghana embarked on independence as one of the richest tropical countries in the world, with an efficient civil service, an impartial judiciary and a prosperous middle class.” Though Ghana has performed better than most of its neighbors on the continent, it is the South Koreas and the Chinas which have shaped the global economy and human history, providing unprecedented improvements in living standards and opportunities for hundreds of millions.

Success has many fathers, but undoubtedly the growth of East Asia has been led by an expansion in the volume and value-added of the region’s exports. An important enabler of this export-led growth strategy, though by no means the only one, has been a highly conducive exchange rate policy. This thesis has explored the theoretical and empirical underpinnings of such a strategy and examined whether this strategy makes sense for Africa’s economic future.

The main finding is that this strategy appears in practice quite difficult to achieve given the political and economic realities on the ground. The Korinek-Serven model discussed in chapter five provides some guidance on how to approach this question. The parameters which would make a strategy of undervaluation through foreign exchange accumulation welfare-increasing do not appear to be satisfied in the African context. However, more data, for example on the capital share of the tradable sectors, would be useful in assessing developments going forward.

Though the theoretical modeling suggests limited benefits from undervaluation, the fact remains Africa’s economies must continue to move up the value chain and significantly expand exports on both the intensive and extensive margins in order to provide the wide-spread economic growth and standard of living enjoyed by their East Asian counterparts. Since opening up under the leadership of Deng Xiaoping, China has seen
an estimated 600 million citizens lifted out of poverty, with a broadening middle class and ever greater modern employment opportunities for the swathes of the rural poor.\textsuperscript{113}

A move towards manufactured exports could have similarly transformative results for the African continent. Improving educational outcomes, promoting technology transfers, providing a more conducive investment climate will all contribute to this goal. Exchange rate policy must also be put at the forefront of the policy debate, especially as many countries will see their currencies pushed up by increasing revenues from natural resources. With an ever-growing youth demographic (estimated to reach 75\% by 2015\textsuperscript{114}) with little formal employment opportunities, Africa’s leaders must look closely to the successes of Asia to create the “African miracle” for the 21\textsuperscript{st} century.

\textsuperscript{113} Chen and Ravallion (2008) \\
\textsuperscript{114} African Economic Outlook (2012)
Appendix

A1. Deriving the Euler equation for optimal investment

Utility maximization
\[ \max U = \max \sum_t \beta_t \left( \frac{C_t^{1-\theta}}{1-\theta} \right) \]
Subject to a budget constraint:
\[ C_t + I = w + R K_t \]
Law of motion of capital:
\[ K_{t+1} = (1 - \theta)K_t + I \]
Transversality condition:
\[ \lim_{t \to \infty} (1 + R - \delta)^{-t}K_t = 0 \]

The Euler equation can be derived using Lagrange multipliers:
\[ L(C_t, C_{t+1}, \lambda) = U(C_t) + \beta U(C_{t+1}) + \lambda \left( y_t + \frac{y_{t+1}}{1 + R_t - \delta} - C_t - C_{t+1} \right) \]

First order conditions:
\[ \frac{dL}{dC_t} = U'(C_t) - \lambda = 0 \]
\[ \frac{dL}{dC_{t+1}} = \beta U'(C_{t+1}) - \frac{\lambda}{1 + R_t - \delta} = 0 \]
\[ \frac{dL}{d\lambda} = y_t + \frac{y_{t+1}}{1 + R_t} - C_t - C_{t+1} \]

Combining:
\[ \frac{\beta U'(C_{t+1})}{U'(C_t)} = \frac{\frac{\lambda}{1 + R_t - \delta}}{\lambda} = (1 + R_t - \delta) \]

Plugging in the specific marginal utilities from the utility equation:
\[ \frac{\beta C_{t+1}^{-\theta}}{C_t^{-\theta}} = \frac{1}{1 + R_t - \delta} \]
\[ \frac{C_{t+1}^{-\theta}}{C_t^{-\theta}} = \left( \frac{C_{t+1}}{C_t} \right)^{\theta} = \beta (1 + R_t - \delta) \]
\[ \frac{C_{t+1}}{C_t} = \left[ \beta (1 + R_t - \delta) \right]^{1/\theta} = 1 + \gamma^{DE} \]
\[ \gamma^{DE} = \frac{1}{\bar{\sigma}} - 1 \]
A2. Deriving the optimal capital and labor ratios

**Optimal capital ratio ($\kappa^*$):**

\[
\frac{q}{q} = \frac{\eta K_N^{\eta-1}(A_NL_N)^{1-\eta}}{\alpha K_T^{\eta-1}(A_TL_T)^{1-\eta}} \left( \frac{\phi}{1-\phi} * \frac{K_N^{\eta}(A_NL_N)^{1-\eta}}{K_T^{\eta}(A_TL_T)^{1-\eta}} \right)
\]

\[
1 = \frac{1-\phi}{\phi} \left( \frac{\eta}{\alpha} \right) \left( \frac{K_T}{K_N} \right)
\]

\[
1 - \frac{\phi}{\frac{\eta}{\alpha}} = \left( \frac{K_N}{K_T} \right) = \kappa^*
\]

**Optimal labor ratio ($\lambda^*$):**

\[
\frac{q}{q} = \frac{(1-\eta)K_N^{\eta}A_N^{-\eta}L_N^{-\eta}}{(1-\alpha)K_T^{\eta}A_T^{1-\alpha}L_T^{1-\alpha}} \left( \frac{\phi}{1-\phi} * \frac{K_N^{\eta}(A_NL_N)^{1-\eta}}{K_T^{\eta}(A_TL_T)^{1-\eta}} \right)
\]

\[
1 = \frac{1-\phi}{\phi} \left( \frac{1-\eta}{1-\alpha} \right) \left( \frac{L_T}{L_N} \right)
\]

\[
1 - \frac{\phi}{\frac{\eta}{\alpha}} = \left( \frac{L_N}{L_T} \right) = \lambda^*
\]
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