

# Export dynamics and diversification in the Lao PDR

## *An analysis of the product space*

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### **Abstract**

*This paper reviews export performance in the Lao PDR over the last 25 years. We find evidence that while the rate of export discovery into new products has been high, the Lao export basket remains undiversified and the country vulnerable to a number of risks. We also find that the Lao export basket is comparatively unsophisticated and dominated by products with low value addition and few linkages to products with higher value addition. More importantly, the country does not appear to be catching up with regional neighbors in terms of the sophistication of its export basket. Our primary conclusion is that it is essential for the Lao PDR to accelerate investment climate reforms as a means of reducing costs and raising returns to the export discovery and survival process. We also make some cautious observations on the possibility of more interventionist policy to improve rates of export diversification, and the movement into products where value addition and the potential for growth is greater.*

### **1. Introduction**

The Lao PDR is among the world's poorest and most underdeveloped countries, yet it is now becoming increasingly integrated into the world economy. While still classified as a Least Developed Country, the country is well endowed with natural resources in terms of minerals, hydro-power and forest products. This presents clear opportunities as well as challenges. Lao PDR has made strong efforts to integrate into the fast-growing regional economy and is beginning to reap the benefits of increased openness through large-scale foreign direct investment and a rising export growth rate. However, despite commendable progress, the Lao PDR remains strikingly dependent on a limited range of exported commodities. This lack of diversification poses a number of risks to the country and may well act as a drag on growth and leave the country susceptible to terms-of-trade shocks.

Thus the aim of this paper is to investigate the export diversification challenge that the Lao PDR is currently facing. The proposed approach is to review the long term trends, changing patterns and performance of Lao exports through the lens of the "product space" methodology. This approach will give us some ideas as to the evolving value and income potential of the Lao export basket, and provide some *hints* as to which sectors might present the country with opportunities for export diversification. As with any methodology, ours is dependent on a number of limiting assumptions; however we believe that with appropriate caveats, cautious inferences can be made for the future direction of trade policy in the Lao PDR.

Section 2 of this paper sets the context by providing an overview of current Lao export performance including measures of export concentration, while also highlighting the particular developmental challenges associated with lack of export diversification. Continuing in Section 3, we introduce the various concepts and terminology to be

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employed under the product space methodology. Section 4 sees the application of the selected methodology to the Lao data, including analyses of export products at the 4-digit level. The Lao data is then mapped onto the product space with visual representations presented throughout Section 5. Finally we make some cautious conclusions for policy in Section 6.

## **2. Setting the Context**

### *Recent trends in Lao exports*

Integration by the Lao PDR into the international economy, although taking place at a comparatively rapid pace, is starting from a low base. Merchandise trade as a share of GDP has risen from barely more than 10 percent in the mid 1980s to around 50 percent at present, still low by international standards. Buoyant demand among fast-growing neighboring countries and (until recently) very high prices for natural resource exports have been key drivers of export growth. Expanding exports, which reached close to US\$ 1.4 billion in 2008, have played a major role in the successful national growth story of the last decade. Exponential growth of exports in minerals (principally copper, and to a lesser extent gold) has been the primary causes of such strong export growth in the Lao PDR. Garments exports, wood and wood products, agriculture, and electric power follow minerals in order of importance. All major sectors have experienced growth, but none has come close to matching the performance of the mining sector. Around half of Lao exports are directed to close regional neighbors (Thailand, Vietnam, China and Malaysia).

Exports of minerals reached over US\$ 700 million in 2008, just over half of total exports. This surge in mineral exports has occurred as a result of both growth in exploitation as two large copper-gold mining operations have been developed, and also due to rises in world prices of commodities. While the volume of Lao mining exports is growing steadily, the value of exports is obviously quite dependent on prices, which have been subject to major fluctuations of late. Almost all of Lao copper is exported to regional neighbors with Thailand taking by far the largest share. This movement of the share of total exports into commodities means that Lao export data is likely to be increasingly volatile in future years as a growing share of exports are subject to the vagaries of world prices.

Hydropower is also a key export growth sector, and one that is less susceptible to volatile commodity prices. Exports of electric power are currently valued at around US\$ 100 million, virtually all of which is sold to Thailand. This value is expected to grow strongly over the next few years as major new hydro investments, including the giant Nam Theun 2, are commissioned. World Bank forecasts suggest that Lao PDR will become increasingly dependent on mining and electric power exports in the years ahead. While these two sectors accounted for some 56 percent of total exports in 2008, this share is expected to rise progressively to 67 percent in 2015 and 77 percent in 2020 (World Bank 2010a).

*The risks of export concentration*

Despite being heavily reliant on a limited number of export products, measures of concentration suggest that at present the Lao PDR is within the range one would expect for a low income developing country. The Herfindahl-Herschmann index<sup>1</sup> for the Lao PDR, although higher than in comparators such as Vietnam and Thailand (implying that Lao exports are less diversified than these two countries), is actually very close to the regional average and somewhat lower than the average for low income countries. A major risk that the Lao PDR will face in the years ahead is that excessive concentration of exports could act as a drag on economic growth and development. There is a large literature that purports to demonstrate the validity of this risk to developing countries, but a useful taxonomy of the ways in which poor diversification can restrict rates of economic growth is provided by Brenton et al (2009) as follows.

First of all, diminishing marginal returns will set in more quickly in economies with a more limited range of export products. Production in any given economy is more likely to be closest to the production possibility frontier if factors of production are employed in the most efficient manner. This is less likely to happen if there are a larger number of major export sectors.

Secondly, less diversified economies will be more susceptible to terms-of-trade shocks. The more diversified a portfolio of export sectors within an economy, the less likely that the economy as a whole will be subject to idiosyncratic or sector-specific shocks. Furthermore, overdependence on export products where world demand is more inelastic (commodities in particular) means that minor changes in patterns of demand are more likely to result in greater volatility in prices (and terms of trade), and thus in aggregate traded values. One could argue that the Lao PDR is already seeing the adverse effects of volatility in the world price of copper.

In addition, sourcing of rents from a narrow range of commodities tends to be associated with weaker governance and institutions. Similarly the evidence suggests that institutions that support growth tend to be stronger when rents are earned incrementally across a wider range of commodities.

Based on such hypotheses, there is a large and growing literature that provides evidence to suggest that high sectoral concentration of exports (i.e. lack of diversification) is associated with lower future economic growth. Lederman and Maloney (2009), while trying to test the strength of the “natural resources curse” hypothesis on economic growth rates, actually find that the core driver of the “natural resources curse” is not the presence of natural resources per se, but the degree of export concentration. Similarly, Hesse (2009) finds empirical evidence of a positive effect of export diversification on per capita GDP growth rates. However, interestingly Hesse also finds evidence of non-linearity. Thus while developing countries see benefits from diversification, developed countries see faster growth from increased specialization, most likely as a result of the differing

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<sup>1</sup> The Herfindahl-Hirschmann index, is calculated as follows:

$$H_y = 100 * \left[ \frac{\sqrt{\sum_i \left(\frac{X_{ij}}{X_j}\right)^2} - \sqrt{\frac{1}{n}}}{1 - \sqrt{\frac{1}{n}}} \right]$$

where  $X_{ij}$  is the country  $j$ 's exports of product  $i$  and  $X_j$  is country  $j$ 's total exports; and  $n$  is the total number of products. The higher the index, which is bounded between 0 and 1, the more a country relies on fewer products for export earnings.

challenges from catch-up industrialization and from innovation at the technological frontier.

### **3. Describing the Methodology**

#### *Concept*

We use a methodology that borrows closely from the insights first put forward by Hausmann, Hwang and Rodrik (2006) in their seminal paper titled “What you export matters”, and further developed in Hausmann and Klinger (2007).

Standard neoclassical literature on industrial specialization tells us that a country’s endowments of capital, labor and natural resources, along with the quality of institutions, are the primary determinants of the relative costs, and therefore, patterns of industry and trade across countries. The Heckscher-Ohlin model tells us that when initial factor endowments are controlled for, the initial pattern of a country’s mix of goods and services exported at a given point in time has no independent effect on future comparative advantage as countries merely export based on the relative abundance of their factors of production. Attempts to force a country’s development path away from the boundaries set by such fundamental characteristics are likely to result in losses of efficiency and hence poorer economic performance.

Even more sophisticated models of technological development such as the “varieties model” (Romer 1987) or the “quality ladders model” (Aghion and Howitt 1992, Grossman and Helpman 1991), while providing for a more robust treatment of technological development across products, still assume a degree of homogeneity that relies on the assumption that the structure of the product space is not important, and therefore does not create sources of path dependence (Hausmann and Klinger 2007).

Hausmann, Hwang and Rodrik’s argument is that the universe of available goods and services that a country may produce (the “product space”) is not homogenous, that not all goods are alike in terms of the consequences of their production for long-run economic development, and that specializing in some goods will bring higher growth compared to specializing in others. Thus countries specializing in the production of “lower value” goods and services, may, as a result of path dependency become stuck with a sub-optimal matrix of production.

Such arguments are based on the identification of market failure in the process of private sector investment and innovation. An earlier paper by Hausmann and Rodrik (2003) informs this view, by describing the concept of “cost discovery”. This argument is one that entrepreneurs face certain costs, but uncertain returns from investing in new products or in investing in incremental innovations of existing products. If the investment is successful the entrepreneur reaps the returns of his investment, but competitors will also copy and there will be large public returns to the entrepreneur’s private investment. If the investment fails, the losses will be carried only by the entrepreneur. The entrepreneur does not account for the returns to his competitors in his utility function, thus aggregate investment in cost discovery is likely to be sub-optimal unless government can find some way to internalize this externality into the utility function of the entrepreneur.

Hence, Hausmann and Rodrik argue that the range and number of goods and services that a country produces may not be determined just by factor endowments and institutional characteristics, but also by the extent to which entrepreneurs can be encouraged to engage in cost discovery.

Klinger and Lederman (2004) develop this concept further, referring to it as “product discovery” and similarly find evidence that market failures arising from imitation and free rider problems may inhibit the emergence of new products in developing

countries. The authors also find empirical evidence that product discovery occurs across a wider spectrum of technological levels and is not limited to sectors that are generally considered as being “dynamic”, including in primary sectors such as agriculture. However, Klinger and Lederman caution that there is no obvious channel through which governments can stimulate increased product discovery. Empirically, they find only that when export growth is high then discoveries are most frequent.

As part of their analysis, Hausmann, Hwang and Rodrik (2005) define the related concepts of *PRODY* (a measure of the “productivity” or “income potential” of a given product), *EXPY* (an aggregate measure of the productivity or income potential of a country’s overall export basket, essentially the weighted average of *PRODY*s), *Path* (a measure of the number of related products connected to a given product) and *Density* (a measure of the technological and skills challenge of producing a given product). Through these tools, the authors attempt to construct a framework through which a country’s current export performance and potential future export performance can be assessed.

*Measuring the income level of a product - PRODY*

We borrow the construct of *PRODY* first developed by Hausmann, Hwang and Rodrik (2005) which, for a given product, is defined as the weighted per capita income of the countries that export that specific product.

Thus, assuming a two-country world, if the Lao PDR exports one cow per year, and China exports nine cows per year, then the *PRODY* for cows will be nine tenths of the average income in China plus one tenth of the average income in the Lao PDR (i.e. comparatively high). Similarly, if the Lao PDR exports nine ducks per year, and China exports one duck per year, then the *PRODY* for ducks will be nine tenths of the average income in the Lao PDR plus one tenth of the average income in China (i.e. comparatively low).

The central idea is that *ceteris paribus* “an economy is better off producing goods that richer countries export”. Since a core determinant of income levels across countries is the relative productivity of workers, it makes sense the richer countries should, on average, export higher products with higher value addition. Hence the measure of *PRODY* provides us with a useful proxy, albeit one with limitations, for the value that countries gain from producing and exporting different goods.

Defining algebraically, the productivity level associated with product *i* is essentially the ratio of the export share of product *i* in country *j* to the sum of export shares of *i* across all countries that export the product, weighted by country incomes. Thus the *PRODY* for product *i* is defined as:

$$= \frac{(\quad)}{\sum (\quad)}$$

*PRODY* reflects the notional income of product *i* and is basically a means of ranking products according to their income potential. The index represents a weighted average of per-capita GDPs. The higher the *PRODY*, the “richer” or more sophisticated the product (since it is comparatively richer countries that are already exporting that product). So any given *PRODY* reflects the capabilities embodied in all the factors that “explain” why a country is rich, such as technological sophistication, access to markets and capital, human capital etc. Thus, for example raw cotton has a *PRODY* or income level of 530, while the value for electronic microcircuits is 11,907.

Hausman, Hwang and Rodrik (2005) find that countries that export goods associated with higher productivity levels grow more rapidly, even after they control for

“initial conditions” such as initial income per capita, levels of human capital and fixed country characteristics.

Hesse (2009) adds to this argument by suggesting that where products are located in a denser area of the product space, they are more likely to see knowledge spillovers and backward-and-forward linkages. This is similar to “industrial clusters” arguments and in line with research by Feenstra and Kee (2004) who find that export product variety explains 13 percent of productivity gains across a panel of 34 countries.

One of the interesting aspects of PRODY is that it does not necessarily correlate with technological sophistication. Some primary products can have very high PRODY (and high value addition), while some higher technology products can have comparatively low values (and low value addition).

In addition, a useful aspect of the concept is that it can give us a more realistic measure of the value that a country gains from a given export. More standard measures of the degree of technological sophistication can be misleading. For example, while China may export high technology (and seemingly high value) iPods, the value addition to China is rather small and limited to assembly only. The real value addition comes from the key components and software design. Thus the PRODY for iPods might be somewhat lower than one might initially expect, precisely for this reason.

As with any general model, the concept of the income level of a product is not without its limitations. As a construct it is necessarily static in nature and not forward looking. Thus while we may know that PRODY for product X is high now, it may not remain so in the future and hence any policy interpretations need to be taken with appropriate care. Nor can we know at the present, which products might demonstrate high income levels in years ahead, they may not even exist at all right now. In addition, since the index is based entirely on exports, no attention is given to imports or serving the domestic market. Hence there may be opportunities for a country to move into high PRODY import competing sectors, but our analysis does not give us this kind of information. Similarly the data does not capture exports of services and suffers from all the usual constraints associated with trade statistics.

Another key critique of the Hausmann, Hwang and Rodrik framework is that PRODY estimates do not take into account the quality of production, as essentially the model assumes homogeneity across products within a given classification. Minondo (2007) find that when proxies for quality are taken into account, then the relationship between export sophistication and economic growth no longer holds. However, such analyses do not give full credence to the importance of knowledge spillovers and learning-by-doing. It is more likely that as countries move into the production of new goods and services, quality will improve incrementally with experience. It is much more difficult to jump directly into the production of a new product at a high level of quality.

#### *Measuring the sophistication of a country's export basket - EXPY*

Once we have established the concept of PRODY, it only requires a simple additional step to construct an estimate for the overall (or average) sophistication of a country's aggregate export basket. Also borrowed from Hausmann, Hwang and Rodrik, this is defined as EXPY.

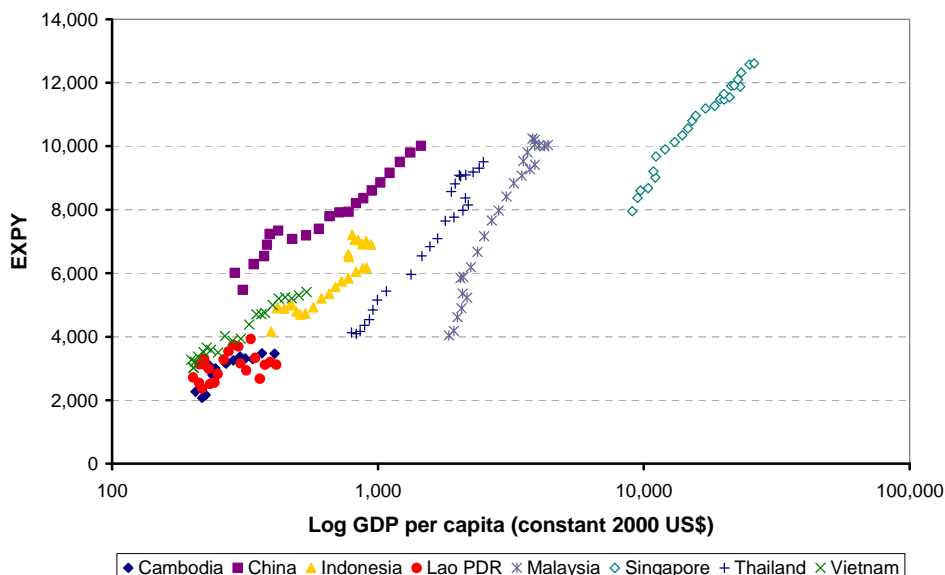
EXPY is a measure of the relative sophistication of a country's export basket and allows us to calculate a single value reflecting the notional income level of a whole country's set of exports. Thus, the sophistication for the export basket for country  $j$  is defined as:

= —

It is the sum of the export shares of each product in a country's basket, multiplied by the PRODY for each export product. Hence a country which exports more relatively sophisticated products (with comparatively higher PRODY) will have a higher EXPY.

Figure 1 shows the path of EXPY plotted against GDP per capita over time for a number of countries in East Asia. Generally the trend is one from bottom left to top right, i.e. over time as countries export more sophisticated products, then per capita income levels rise (or as incomes rise, countries export more sophisticated products). The slope of the ascent differs across countries, and hence a key question one would ask is: "what factors determine the rate at which countries move up into a more sophisticated basket of export products?" It is interesting to see that the Lao PDR does not, however, demonstrate a clear trend. If anything, the country appears to be moving without any clear trend.

**Figure 1:** Plot of export basket sophistication against GDP per capita



A closer inspection of the same chart reveals a clear break in trend before and after the Asian crisis (

Figure 2). Prior to the 1997-98 Asian financial crisis, Lao PDR was moving on a clear upward path of increasing export sophistication. However in the years since the crisis, the trend appears to have been slightly downwards. The 1997-98 crisis had a major impact on the Lao PDR with a tenfold depreciation in the domestic currency against the US Dollar in the years immediately after the crisis hit.

Nevertheless, by converting both the data on both horizontal and vertical axes into Purchasing Power Parity (PPP) terms, we see a different post-crisis result for the Lao PDR (Figure 3). As in

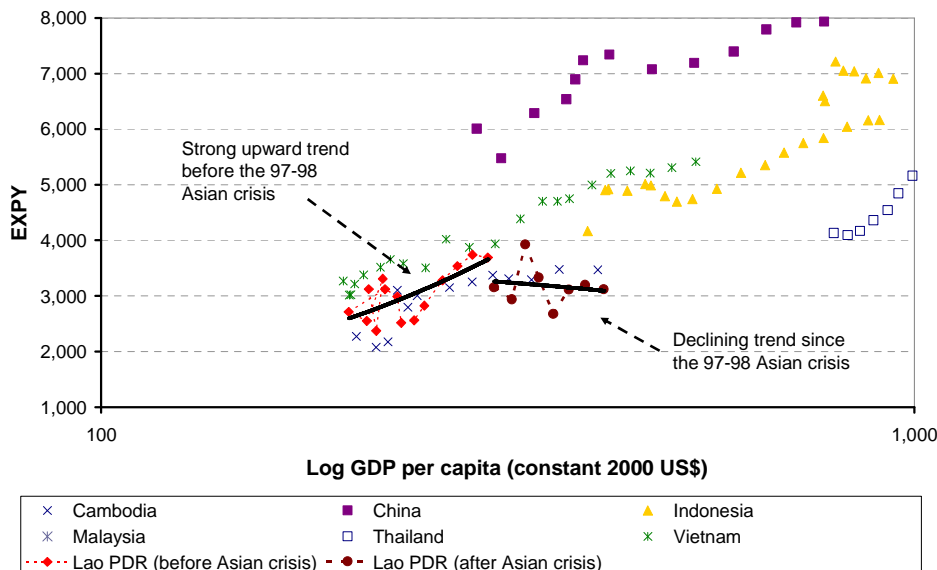
Figure 2, the trend line of EXPY against GDP per capita is rising upward prior to the 97-98 crisis. Also as above there is a clear break in trend after the crisis. But this time, the trend after 1998 continues upwards, albeit at a much slower rate. This suggests that the post-crisis data in

Figure 2 may be distorted by the extreme exchange rate movements witnessed in the Lao PDR at that time.

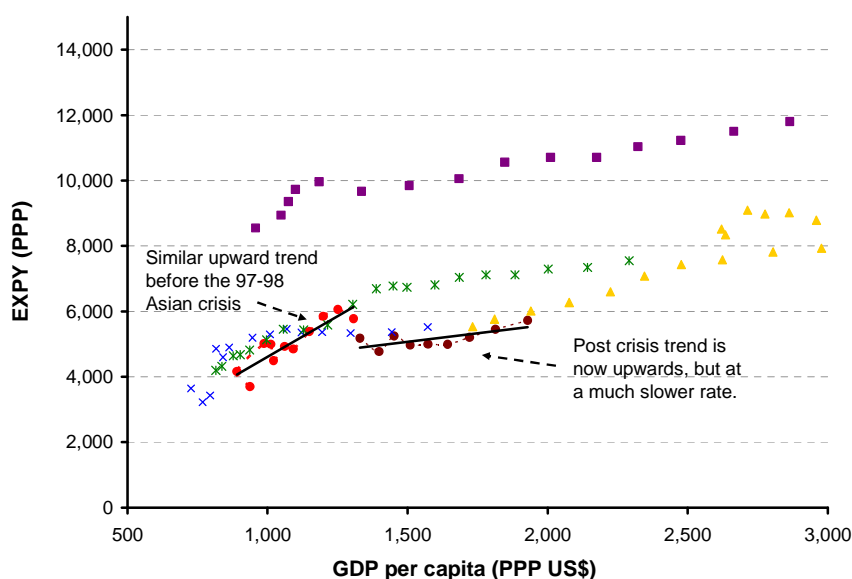
While it would be imprudent to draw any strong conclusions based on the slope of the trend line for export sophistication after the 1997-98 crisis (it may not even be statistically significant), it is clear that there was a break in trend and that in more recent years the Lao PDR has struggled to catch up with regional competitors. This means that while Lao

exports may have expanded during this period (and the country has become more open), the average income level of exported products has not increased.

**Figure 2:** Time series plots of export basket sophistication against GDP per capita, Lao PDR and selected countries



**Figure 3:** Time series plots of export sophistication against GDP per capita in PPP terms, Lao PDR and selected countries



*A means of classifying products*

Having prepared a framework of analysis that uses the concepts of the product space, the income level of an export product (PRODY) and sophistication of a country’s export basket (EXPY), the next stage in our methodology is to devise a means of classifying export products into different categories of analysis. For this step, we use the concept of “revealed comparative advantage” (RCA), first developed in work by Balassa (1965).

RCA is a measure of the relative export performance by a country for a specific export product, defined as a country's share of world exports in the given product, divided by the country's share of total world exports.

We define the Revealed Comparative Advantage (RCA)<sup>2</sup> for country "j" in product "i" as:

$$= \frac{\sum}{\frac{\sum}{\sum}}$$

Thus if  $RCA > 1$ , one can say that country  $j$  has a revealed comparative advantage in product  $i$ .

We use calculations of the RCA for Lao PDR's major export products as a means of filtering export products into four main categories: classics (those which have demonstrated an RCA consistently over the long run); disappearances (those which previously demonstrated an RCA, but no longer do so); emerging champions (those which previously did not demonstrate an RCA, but now do); and marginals (those which have never demonstrated an RCA).

*Measuring the export diversification potential of a product - path and product distance*

Returning to the product space, the next related concept, *path* or *product distance*, is a measurement of the revealed distance between any two products within the product space matrix. Calculating path gives us an indication as to whether any given product is located in a particularly dense or sparsely populated part of the product space. If the path or product distance is short, then this would imply that factors of production, skills and technology can be more easily deployed from one product to another, compared to if the product distance is long.

The product distances ( ) for each pair of products  $a$  and  $b$  are calculated using the minimum of two conditional probabilities, the probability that a country has an RCA in product  $a$ , given that a country has an RCA in product  $b$ , and vice versa.

$$= \min \{ ( \quad | \quad ), ( \quad | \quad ) \}$$

The product path is then calculated as a measure of the extent to which countries that export any given product, are likely to export other products and thus can be seen as a notional value of the potential for future export diversification associated with any particular product. Path is defined as follows:

$$h =$$

Thus, for example, we find that the path for copper (105) is low compared to the path for footwear (149). This means that there are more opportunities to diversify into other products from footwear, than from copper. Within the product space, footwear is surrounded by a much larger number of related products, while copper is located in a more sparsely populated area.

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<sup>2</sup> We note that RCA can be defined in a number of ways – see Vollrath (1991) for a summary.

#### 4. Analysing the Lao Data

The first step of analysis at the product level is to classify products in the export basket of the Lao PDR into four categories according to “Revealed Comparative Advantage”.

Based on an inspection of the long term trends for Lao exports we have used the period 1985-89 as the starting period since this appears to be the point at which severe trade distortions ended and Lao exports became primarily dependent on market based factors, rather than preferential trade with the former Soviet Union. The end period of analysis, the most recent period for which we have reasonably accurate data, is 2004-06<sup>3</sup>. Thus products are grouped into the four categories:

- Classics (products in which Lao’s RCA in the earlier period was high and in recent periods continues to remain high);
- Disappearances (products in which Lao’s RCA in the earlier period was high but is now low),
- Marginals (products in which Lao’s RCA was low in both the earlier and recent periods); and,
- Emerging champions (products in which Lao’s RCA was low in the earlier period but is high in the recent period).

Using 4-digit SITC data, we have a total list of 784 products exported by the Lao PDR during the period running from 1985 until 2006. Products are then filtered to select only those where annual exports were on average above US\$ 500,000 per year in 2004-06 for the classics, marginals and emerging champions, and above US\$ 500,000 per year in 1985-89 for the disappearances. This accounts for 97 percent of Lao exports in the year 2006.

The result is a list of 54 major products, of which there are 6 classics, 2 disappearances, 36 emerging champions, and 10 marginals (Table 1).

**Table 1:** Summary framework of comparative advantage for Lao exports

Matrix	Product	By Tech Category						Average PRODY	Average Path	Average sum of exports (US\$ m)				
		P P	H V	R B	L T	M T	H T			Average share of total exports (%)				
										85-89	90-94	95-99	00-04	05-06
<b>Classics</b>	6	4	-	2	-	-	-	2,472	102	20.1 (63.5 %)	57.1 (49.5 %)	73.2 (29.5 %)	133.7 (37.1 %)	144.5 (20.9 %)
<b>Disappearances</b>	2	-	-	2	-	-	-	7,435	134	5.5 (16.4 %)	9.2 (6.9% )	15.1 (5.9% )	2.8 (0.7% )	0.4 (0.1% )
<b>Emerging Champions</b>	36	9	3	7	16	-	1	5,849	121	2.4 (7.8 %)	43.9 (32.5 %)	141.2 (57.2 %)	173.0 (47.6 %)	563.5 (73.4 %)
<b>Marginals</b>	10	2	-	7	1	-	-	8,181	125	1.8 (2.4 %)	2.0 (1.4% )	6.2 (2.4% )	4.9 (1.3% )	17.5 (2.6% )
<b>Totals</b>	54	15	3	18	17	0	1	5,414*	117*					

Source: Authors’ calculation using Comtrade data, \*weighted by export shares for 2004-06

<sup>3</sup> Note that since the Lao PDR authorities do not report trade statistics to international bodies, all data used here is mirror data from Comtrade and is likely to include transport costs.

Table 2 shows the full list of the 54 major products, ranked in order of export value within each of the four categories. The average weighted income level for Lao exports in 2005-06 (our measure of the sophistication of the export basket, or EXPY) is 5,414. Similarly the weighted average path is 117.

**Table 2:** Full list of products (classics, disappearances, emerging champions and marginals)

ID (SITC)	Product Name	Tech category	PRODY	Path	Count
<b>CLASSICS</b>					
<b>(rca8589=1, rca0406=1) filtered with exports &gt;USD 500,000 in 05-06</b>					
2483	Wood of non-coniferous species, sawn	Resource Based 1	3,667	110	
2472	Sawlogs and veneer logs, of non coniferous	Resource Based 1	2,287	96	
0711	Coffee, whether or not roasted	Primary Products	1,936	85	
2922	Shellac, seed lac, stick lac, resins	Primary Products	987	96	
2924	Plants, seeds, fruit used in perfume	Primary Products	3,622	105	
2923	Vegetable matter	Primary Products	2,334	123	
<i>Average</i>			<i>2,472</i>	<i>102</i>	<i>6</i>
<b>DISAPPEARANCES</b>					
<b>(rca8589=1, rca0406=0) filtered with exports &gt;500,000 in 85-89</b>					
2471	Sawlogs and veneer logs, of coniferous	Resource Based 1	8,841	139	
2882	Other non-ferrous base metal waste	Resource Based 2	6,030	129	
<i>Average</i>			<i>7,435</i>	<i>134</i>	<i>2</i>
<b>EMERGING CHAMPIONS</b>					
<b>(rca8589=0, rca0406=1) filtered with exports &gt;USD 500,000 in 05-06</b>					
6821	Copper and copper alloys, refined	Resource Based 2	4,900	105	
3510	Electric current	High Tech 1	8,874	151	
8451	Jerseys, pullovers, twinsets, cardigans	Low Tech 1	4,464	119	
8423	Trousers, breeches etc. of textile fabrics	Low Tech 1	4,789	122	
8462	Under garments, knitted of cotton	Low Tech 1	4,975	113	
8441	Shirts, men's, of textile fabrics	Low Tech 1	4,936	124	
8459	Other outer garments & clothing, knitted	Low Tech 1	6,020	118	
8439	Other outer garments of textile fabrics	Low Tech 1	5,408	125	
8463	Undergarments, knitted, of synthetic fabrics	Low Tech 1	6,207	131	
9710	Gold, non-monetary	Resource Based 2	5,716	106	
2320	Natural rubber latex; natural rubber	Primary Products	1,169	56	
8510	Footwear	Low Tech 1	7,765	149	
2482	Wood of coniferous species, sawn, planks	Resource Based 1	11,578	133	
0440	Maize (corn), unmilled	Primary Products	6,430	114	
6344	Wood-based panels, n.e.s.	Resource Based 1	7,848	138	
8429	Other outer garments of textile fabrics	Low Tech 1	5,624	132	
3222	Other coal, whether/not pulverized	Primary Products	12,166	97	
2732	Gypsum, plasters, limestone flux	Primary Products	5,721	135	
8993	Candles, matches, pyrophoric alloys	Low Tech 2	8,437	153	
0459	Buckwheat, millet, canary seed, grain	Primary Products	5,009	94	
2876	Tin ores and concentrates	Resource Based 2	1,685	47	
0548	Vegetable products, roots & tubers	High Value PP	4,789	108	
8431	Coats and jackets of textile fabrics	Low Tech 1	6,511	146	
0545	Other fresh or chilled vegetables	High Value PP	5,477	122	

8434	Skirts, women's, of textile fabrics	Low Tech 1	5,544	137	
8424	Jackets, blazers of textile fabrics	Low Tech 1	7,794	145	
2221	Groundnuts (peanuts),green, whether	Primary Products	2,739	101	
6341	Wood sawn lengthwise, sliced/peeled,	Resource Based 1	5,237	136	
8421	Overcoats and other coats, men's	Low Tech 1	6,423	143	
2225	Sesame seeds	Primary Products	1,179	93	
0011	Animals of the bovine species	Primary Products	4,391	128	
8433	Dresses, women's, of textile fabrics	Low Tech 1	5,790	141	
6359	Manufactured articles of wood, n.e.s	Resource Based 1	9,089	159	
8435	Blouses of textile fabrics	Low Tech 1	5,783	132	
2929	Other materials of vegetable origin	High Value PP	5,977	121	
0421	Rice in the husk or husked	Primary Products	4,101	97	
<i>Average</i>			<i>5,849</i>	<i>121</i>	<i>36</i>
<b>MARGINALS</b>					
<b>(rca8589=0, rca0406=0) filtered with exports &gt;USD 500,000 in 05-06</b>					
6672	Diamonds, unworked cut/otherwise worked	Resource Based 2	5,607	79	
6822	Copper and copper alloys, worked	Resource Based 2	9,728	158	
0422	Rice semi-milled or wholly milled	Primary Products	4,455	99	
8219	Other furniture and parts	Low Tech 2	10,855	168	
6353	Builders' carpentry and joinery	Resource Based 1	13,115	152	
0565	Vegetables, prepared or preserved, n.e.s	Resource Based 1	8,482	145	
2613	Raw silk (not thrown)	Primary Products	2,861	47	
1222	Cigarettes	Resource Based 1	12,204	142	
0589	Fruit otherwise prepared or preserved	Resource Based 1	9,337	136	
2875	Zinc ores and concentrates	Resource Based 2	5,171	119	
<i>Average</i>			<i>8,181</i>	<i>125</i>	<i>10</i>

Source: Authors' calculation using Comtrade data

### *Classic products*

As can be seen from Table 1 and Table 2, of the six classics –that is those products which have demonstrated consistent and long run revealed comparative advantage– four are primary products and two are resource based.

The share of the classics –those export products that are traditional in the Lao PDR– has declined noticeably during the period under review. In 1985-89, the classics accounted for a majority 63.5 percent of Lao exports. The share in 2005-06 was just 20.9 percent. Hence several of the classics may in fact be on the verge of entering the disappearances category. The average income level (PRODY) of the classics is comparatively low at 2,472, as is the scope for further diversification (Path) at 102. This implies that the average income of countries that export the Lao classics is low and hence, we can conclude, the returns to exporting these products are comparatively low. The low path of these products implies that the factors of production employed in producing these products cannot be easily redeployed to alternatives.

### *Disappearing products*

The two disappearances –products that no longer demonstrate RCA– are both resource based products and now account for less than half a percent of Lao exports. However, exports of these two products peaked at 15.1 percent during 1995-99. It is revealing to note that exports of unprocessed coniferous sawn logs are one of the disappearances, presumably not because of lack of external demand, but as a result of better enforcement of rules prohibiting exports of unprocessed, high value logs.

### *Emerging products*

The large number of emerging champions –products where RCA has emerged during the period under review– implies that there has been a strong process of export discovery during recent years in the Lao PDR. The two largest and most significant discoveries (copper and electric current) have occurred in the natural resources sector.

For the Lao PDR, sectors that might be considered traditional in other countries are modern by virtue of their newfound importance. Electric current is the Lao PDR's only major “high tech” product, according to our classification. It also has a high figure for path, implying that countries that export electric power are more likely to export diversified products. This makes sense as the availability of large scale electric power is often a prerequisite for the development of major industrial and mineral extraction processes.

Lao exports appear to have been driven by the *extensive margin* (new trade flows) rather than the intensive margin of trade (expansion of existing trade flows). The share of total exports of the emerging champions has risen steadily from 7.8 percent in 1985-89 to 73.4 percent in 2005-06. This is contrary to much of the literature on exports from low-income developing countries, which suggests that most developing economies see growth driven through the expansion of trade in existing export products, rather than the generation of new products (see Besedes and Prusa 2007, and Brenton and Newfarmer 2007 for more on this). However, while we can say that high rates of export discovery in the Lao PDR have seen growth in exports of numerous new products, the tendency has been for the new products to be exported to existing markets.

**The sluggish growth in the sophistication of the Lao export basket is driven partly by the fact that the average income value of the new export product discoveries is lower than that of the disappearing export products. From our earlier analysis of the slow rate of growth in EXPY (**

Figure 2 and Figure 3), it would appear that an explanation for this trend would be that many of the Lao emerging champions have lower income values (PRODY) than the disappearances. Indeed the average income value for the emerging champions is lower than the average for the disappearances. Nevertheless, it would be rash to then conclude that diversification has been a poor outcome for the Lao PDR. In the first case there is the advantage of relying on a wider and more diversified basket of export products. This has value in itself in terms of reduced vulnerability to terms of trade shocks etc. Secondly while the average PRODY and Path for the emerging champions is lower than for the disappearances, there is much variety and the list includes a number of products with very high income values and significant scope for diversification.

While the classic and disappearing products are entirely basic primary and resource based products, the list of emerging champions includes a number of products in higher technology categories that present encouraging opportunities for further diversification. A large cluster of interrelated garments products have emerged in the Lao PDR, all classified as “low tech”. While the income value of most of these garments products is comparatively low (and in most cases slightly below the average PRODY for the Lao export basket), the scope for diversification is comparatively high and above the average Path for the Lao export basket. This implies that there is potential to expand into higher income value sectors and that experience gained with factors of production deployed producing the current set of garments products, can be comparatively easily redeployed into other related products over time.

Generally outerwear (where export volumes are comparatively lower) seems to have higher income values and figures representing scope for diversification than underwear, shirts and trousers (the garments sectors where Lao exports are the largest). It

is also interesting to note that the PRODY and Path for footwear (also one of Lao PDR's emerging champions) are both higher than for Lao garments exports.

A number of wood products feature in the list of emerging champions with starkly differing product income values, according to our measures. Even modest transformations from sawn logs appear to result in significantly higher PRODY and Path values. The product category "manufactured articles of wood" has the highest scope for diversification of all of the Lao PDR's emerging champion export products (a Path of 159).

Vegetable products offer much greater returns and scope for diversification than grains. The list of emerging champions includes several agricultural commodities which have varying product income levels but uniformly limited scope for diversification. Maize, rice and other grains have reasonably high income values (high PRODY), but comparatively limited scope for diversification (low Path). Groundnuts and sesame show low values for both income and diversification potential. In contrast, vegetable products appear to have high income values and greater scope for diversification compared to other agricultural commodities. Even minor processing of vegetables, or the development of fresh and chilled supply chains, appears to result in significantly higher PRODY and path figures.

Tin, coal and gold also stand out as natural resource-based emerging champions with varying income values, but all with relatively limited opportunities for diversification. This implies, as with other major natural resource sectors, that the Lao PDR gains significant value from exporting minerals, but the opportunity to add value and move into new products is rather limited.

Rubber also stands out as a product presenting low income returns and very limited opportunities for diversification. A handful of emerging champions stand out as having very low PRODY and very low paths, including natural rubber and tin. Rubber has a very low PRODY of just 1,169 (the lowest of all emerging champions, and the second lowest of the entire Lao export basket) and the path is among the lowest for Lao exports. This means that factors of production deployed in the production of rubber earn a comparatively low rate of return, and skills gained are not easily transferrable to other sectors.

### *Marginal products*

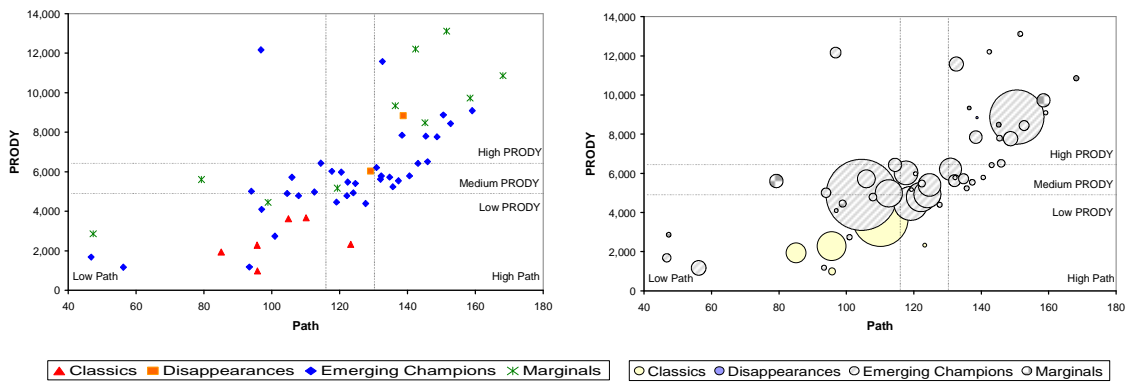
The group of ten marginal products is a diverse group, and includes some products with very high income values and highly significant potential for diversification. Processing of wood into carpentry products and furniture appears to result in significantly higher PRODY. Similarly, exporting worked copper earns double the income value of more basic refined copper. Fruits and preserved vegetable products also have income values and measures of scope for diversification. Cigarettes stand out as a manufactured good with one of the highest income values in the Lao export basket. Interestingly, while raw silk appears as a marginal export, it has very low PRODY and Path.

### Reviewing the Lao export basket

Scatter plots of product income levels against diversification potential for the Lao export basket show a positive relationship and reveal that while there are a large number of products located in the upper right corner (high income and high scope for diversification), the most significant products when weighted in terms of share of total Lao exports are actually closer to the lower left (low income and low scope for diversification) (Figure 4). Thus the greater volume of products exported by the Lao PDR lay within a region of the product space where there are comparably few linkages and opportunities to redeploy factors of production into new activities.

Similarly the two charts in Figure 5 show plots of income levels against Density and demonstrate a negative relationship. Density is a concept, allied to Path. Thus while Path represents a metric of the number of linkages and distance between one product and others in the product space, Density is a measure of the ease with which a country's factors of production and institutional arrangements deployed to produce product  $x$  can be redeployed to produce product  $y$ . Density is bounded between 0 and 1, and for each product measures how close one specific product is to the country's current production capabilities. Expressed in different terms, Path is a measure of the potential for future diversification, while Density is a measure of the ability of a country to take advantage of that potential.

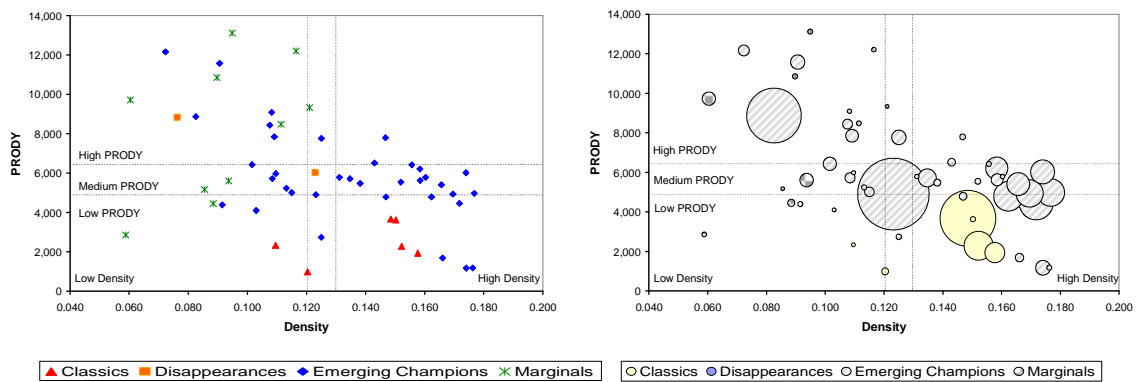
**Figure 4:** Un-weighted and weighted plots of product income levels against measure of the scope for diversification, Lao PDR



Source: Authors' calculation using Comtrade data

The two charts in Figure 5 show an inverse relationship between PRODY and Density. This suggests, as one might expect in a low-income developing country, that the Lao PDR has greater export capability in products where the income level is lower. Scores for Density are generally higher in the classic products compared to in the emerging champion and marginal products, as the country has longer experience producing the classic products.

**Figure 5:** Un-weighted and weighted plots of product income levels against measure of the ease of diversification, Lao PDR



Source: Authors' calculation using Comtrade data

An examination of the weighted plot shows (with the exception of electric current), that the bulk of Lao exports are located in the bottom right of the chart. This means that

the Lao PDR’s current export capabilities are embodied in the production of lower value products. Hence it will be challenging to redeploy factors of production used away from the lower income products in the Lao export basket, towards the higher income products.

**What is the “product space”?**

The *Product Space* is a concept that provides for a network representation that depicts a *Map* of products traded across countries. The concept borrows heavily from the biological sciences. All countries face the same map of the product space, but will only trade a limited subset of products. Each *node* in the map represents a product codified according to the Standard International Trade Classification (SITC) system. The idea can be explained through the following analogy:

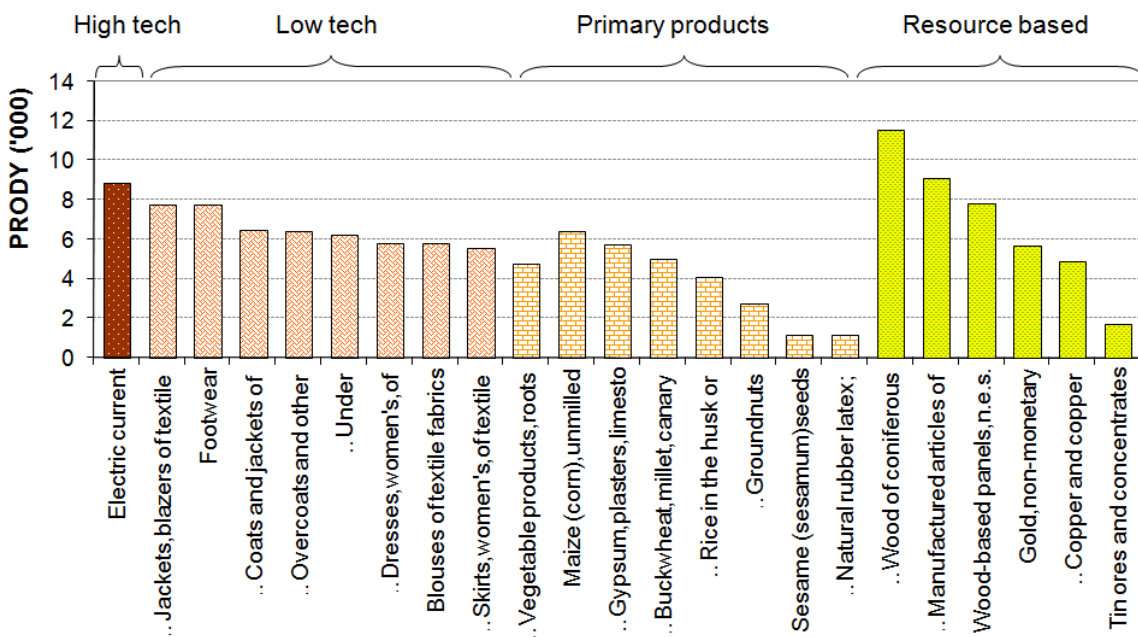
*“Think of a product as a tree and the set of all products as a forest. A country is composed of a collection of firms, i.e., of monkeys that live on different trees and exploit those products. The process of growth implies moving from a poorer part of the forest, where trees have little fruit, to better parts of the forest. This implies that monkeys would have to jump distances, that is, redeploy (human, physical, and institutional) capital toward goods that are different from those currently under production. Traditional growth theory assumes there is always a tree within reach; hence, the structure of this forest is unimportant. However, if this forest is heterogeneous, with some dense areas and other more-deserted ones, and if monkeys can jump only limited distances, then monkeys may be unable to move through the forest. If this is the case, the structure of this space and a country’s orientation within it become of great importance to the development of countries”.*

Source: Hidalgo et al (2007)

**5. Mapping the Product Space**

One of the useful aspects of our measure of the income level of a product (PRODY) is that it allows us to classify exports according to a measure other than technological sophistication. As can be seen in Figure 6, primary products may have higher “income” or “productivity” levels than low tech products. Similarly resource based products can have very low income values (comparable to some primary products), and also very high values (greater than some high tech products).

**Figure 6:** Comparisons of income level for selected major products exported by the Lao PDR



Source: Authors' calculations using Comtrade data and classified according to standard categories

The final stage of our analysis is to plot the 54 major Lao export products on the product space map. The product space is essentially a graphical interpretation of the relationships and spatial linkages between products, according to income level (PRODY) and scope of diversification (Path). The product space network is the same for all countries, but obviously each country produces only a limited proportion of the total number of products on the map. Altogether, there are 775 products (or nodes) in the product space map (according to the SITC classification of products) and 1,525 linkages. The location of any given product is determined by the number of linkages between that product and others. Thus products with fewer linkages (such as commodities) are located towards the sparsely populated periphery while more complex products with interrelated components are located towards the denser core. The size of the nodes reflects the share of a product within world trade flows.

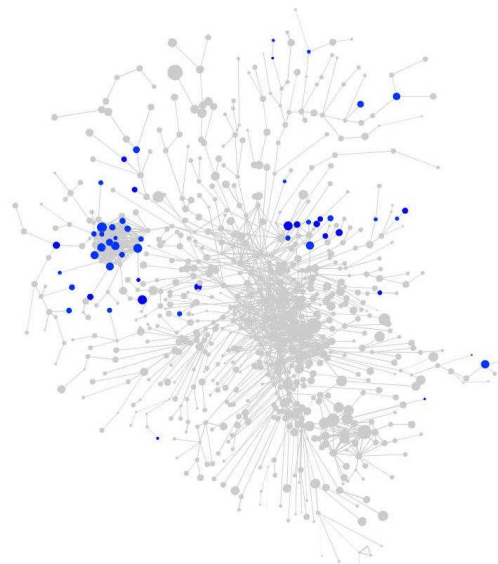
When viewing the product space maps, it is important to note that products located close to each other do not necessarily need to be alike. The distance between two products is determined by the likelihood of countries exporting both products, and hence it is the similarity of endowments in factors of production which is the key underlying determinant of closeness.

A map of the Lao product space shows that that the majority of products are located around the sparsely populated periphery, with the centre almost entirely empty. Figure 7 shows the Lao product space, along with maps for Vietnam, Cambodia and Mongolia as comparisons.

**Figure 7:** The product space for the Lao PDR, Vietnam, Cambodia and Mongolia

### **Lao PDR**

*The Lao product space map is sparsely populated, indicating the limited number of products where the country achieves critical export mass. No products are located at all in the centre. A cluster of spots on the left hand side of the map indicates export activity in the garments sector, and to a lesser extent on the right hand side in the wood products sector. Most products are located on the periphery, with limited linkages to other products and limited opportunities for diversification.*



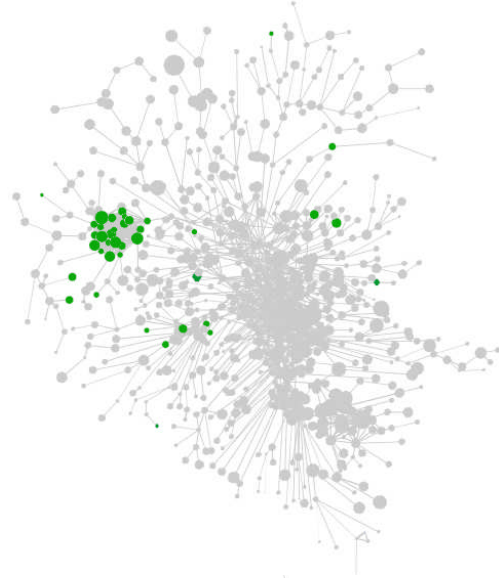
**Vietnam**

*Vietnam's greater export capacity is reflected in a much more populated map of the product space. While the map still reflects that of a low-income country, Vietnam is exporting a number of products that have high income and dense linkages, close to the centre of the product space.*



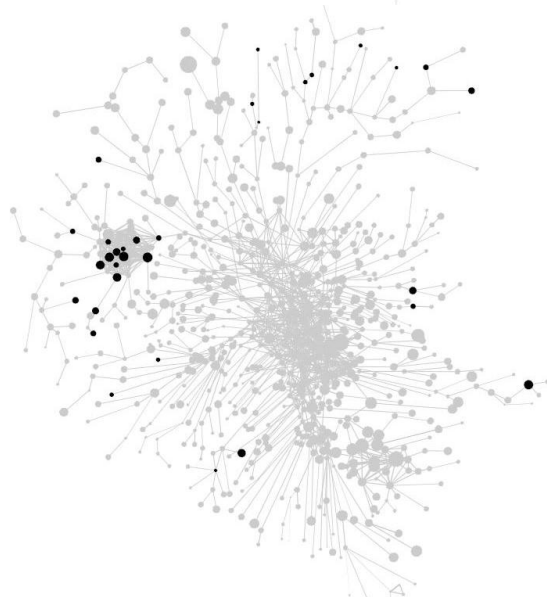
**Cambodia**

*Cambodia appears less diversified than the Lao PDR with a thinly populated product space map. However, the garments grouping on the left hand side of the map is more densely populated as a reflection of the country's relatively developed export capacity in this sector.*



**Mongolia**

*The product space for Mongolia is dispersed with products scattered around the commodities of the periphery. There is some modest evidence of activity in the garments region of the map.*



Source: Authors' estimates

The remaining charts in this section are more detailed representations of the Lao product space, with products classified according to our breakdown into classic products (those where the Lao PDR has exhibited long run comparative advantage); the disappearances (products where previous comparative advantage has been lost); the emerging champions (products where comparative advantage has been discovered); and the marginals (products there Lao exports are significant, but there is not comparative advantage).

Figure 8 presents the overall product space map for the Lao PDR, with products codified according to the four categories outlined above. It is clear that the Lao PDR is only exporting within a small part of the product space, and almost entirely in the periphery. There appear to be two modest groupings of related products – one in the garments sector (towards the centre left of the product space) and one in the wood products sector (towards the centre right of the product space). The core is entirely empty.

Figure 9, Figure 10, Figure 11 and

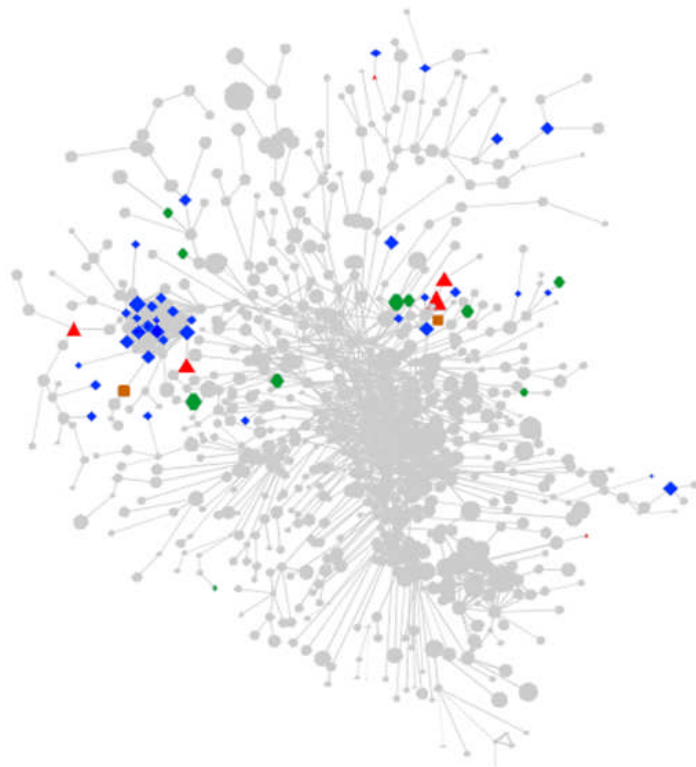
Figure 13 present labeled summaries of the product space for the classics, disappearances, emerging champions and marginals respectively.

Figure 12 presents a zoomed in view of the garments grouping within the product space map.

**Figure 8:** Product Space Map for the Lao PDR (all major products)

**Product Space**

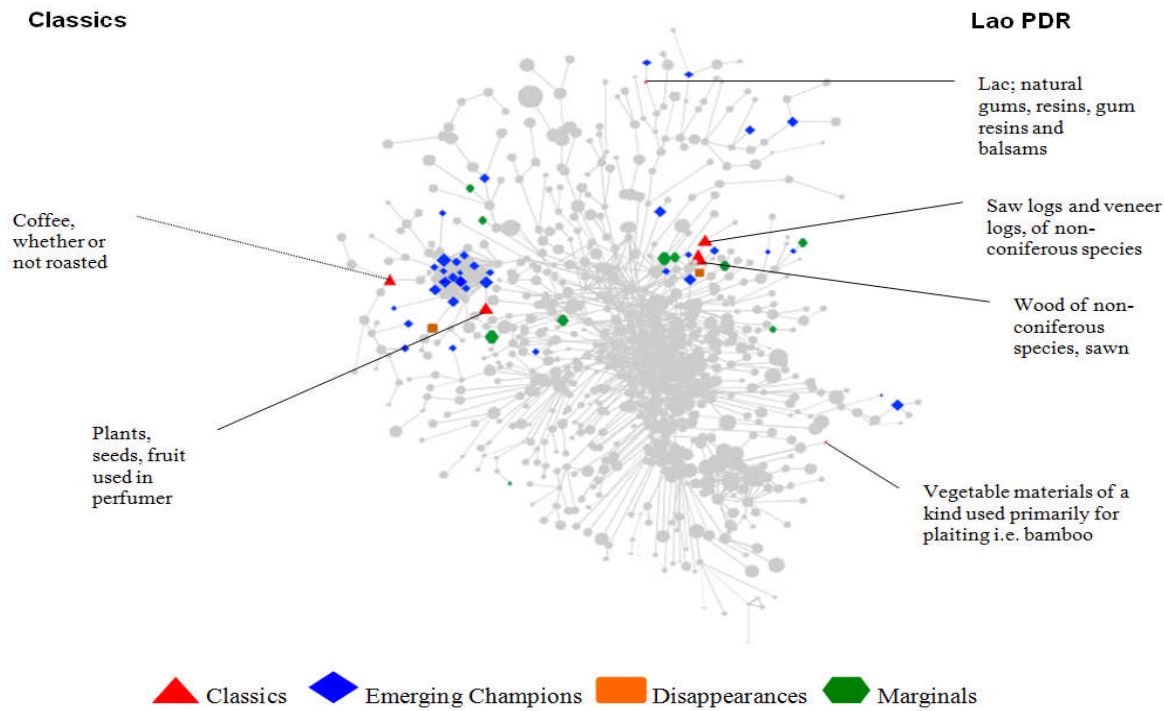
**Lao PDR**



▲ Classics    ◆ Emerging Champions    ■ Disappearances    ⬡ Marginals

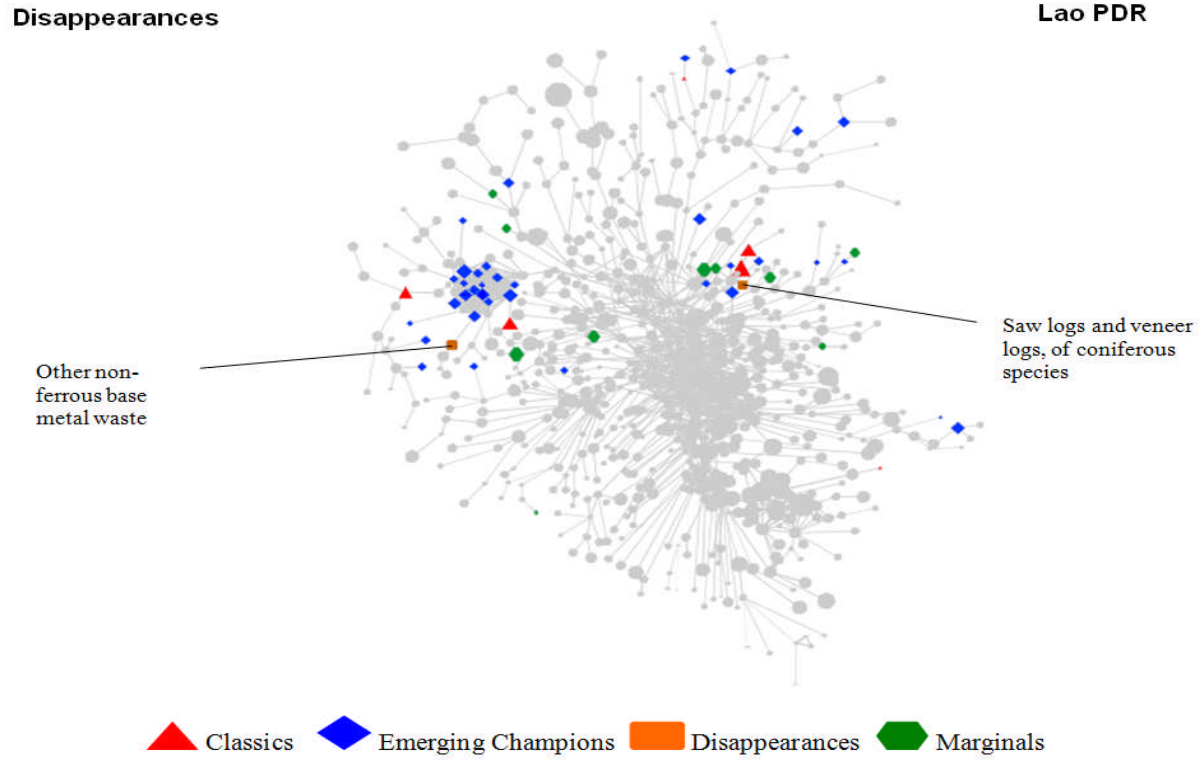
Source: Authors' estimates / Map generated using software by Hidalgo, et. al. (2007) available in <http://www.nd.edu/~networks/productspace/index.htm>

**Figure 9:** Product Space Map for the Lao PDR (classics/products where Lao PDR demonstrates long-run comparative advantage)



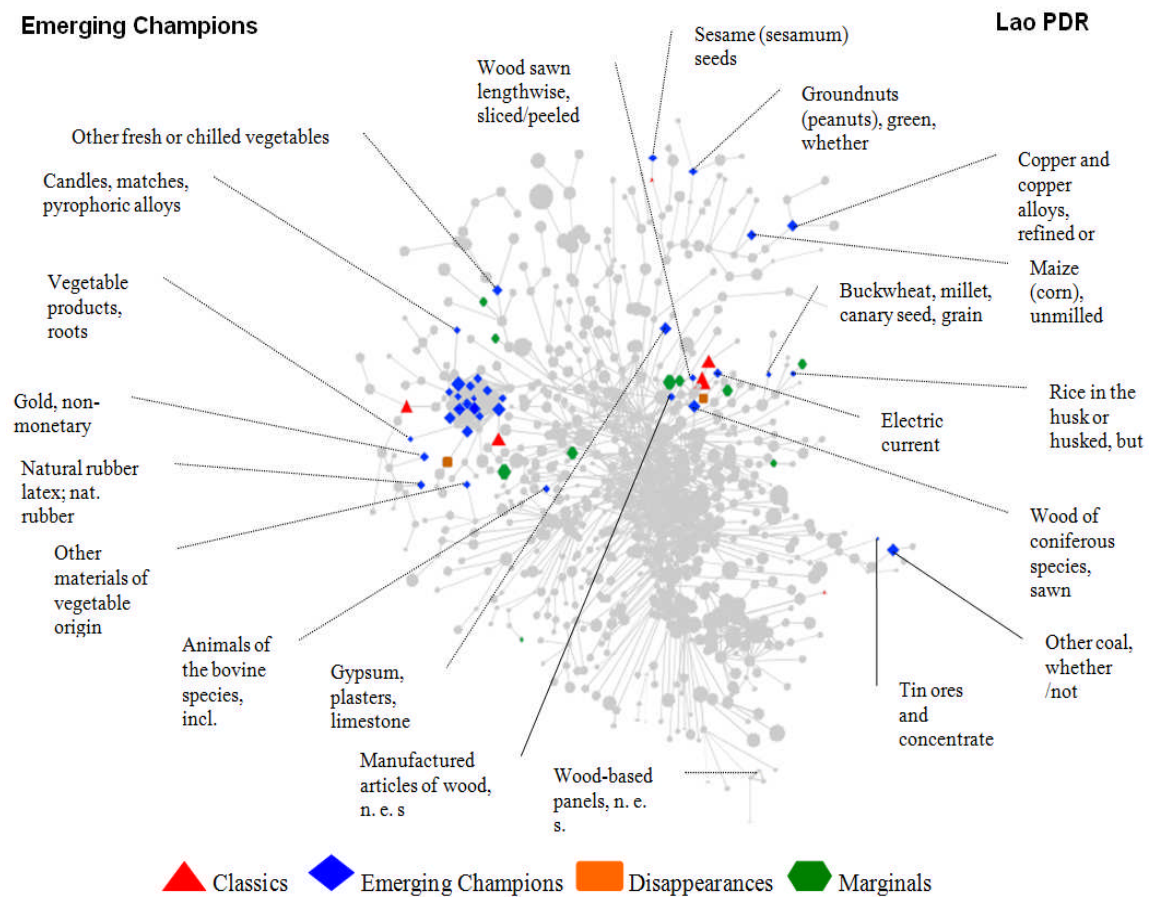
Source: Authors' estimates / Map generated using software by Hidalgo, et. al. (2007) available in <http://www.nd.edu/~networks/productspace/index.htm>

**Figure 10:** Product Space Map for the Lao PDR (disappearances/products where earlier comparative advantage has been lost)



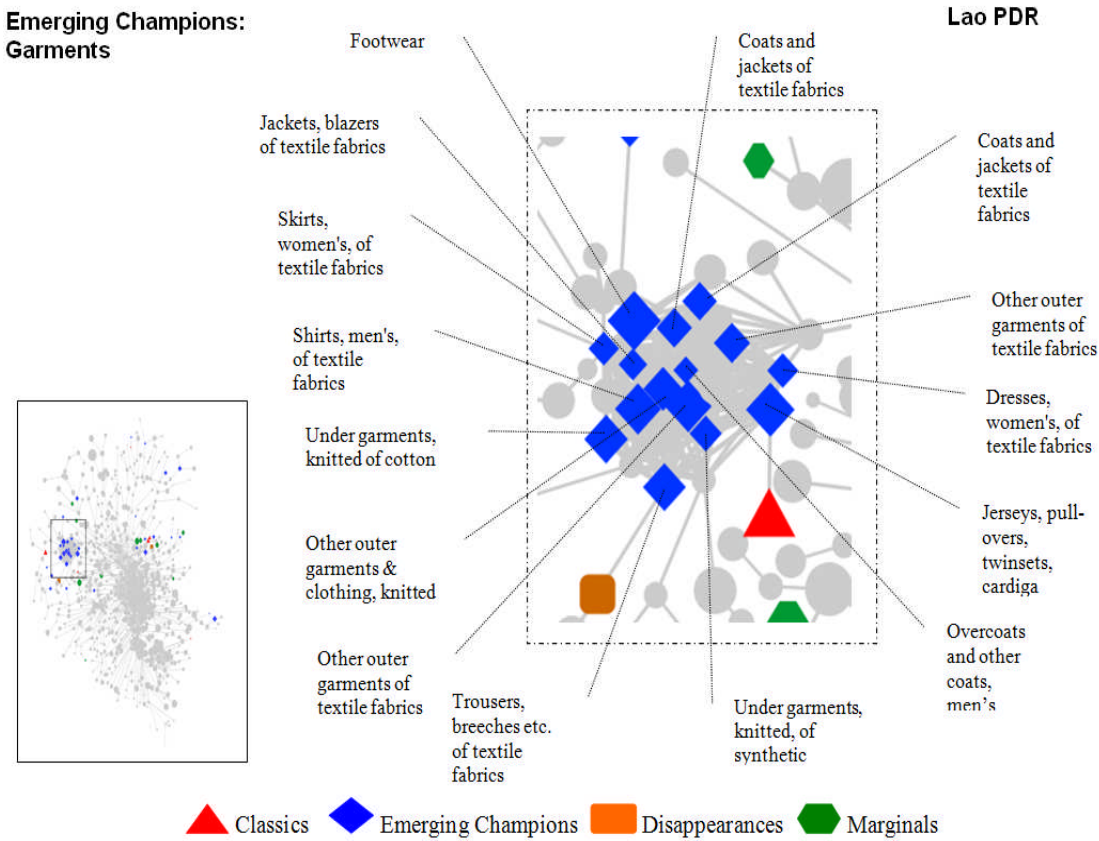
Source: Authors' estimates / Map generated using software by Hidalgo, et. al. (2007) available in <http://www.nd.edu/~networks/productspace/index.htm>

**Figure 11:** Product Space Map for the Lao PDR (emerging champions/products where comparative advantage has been discovered)



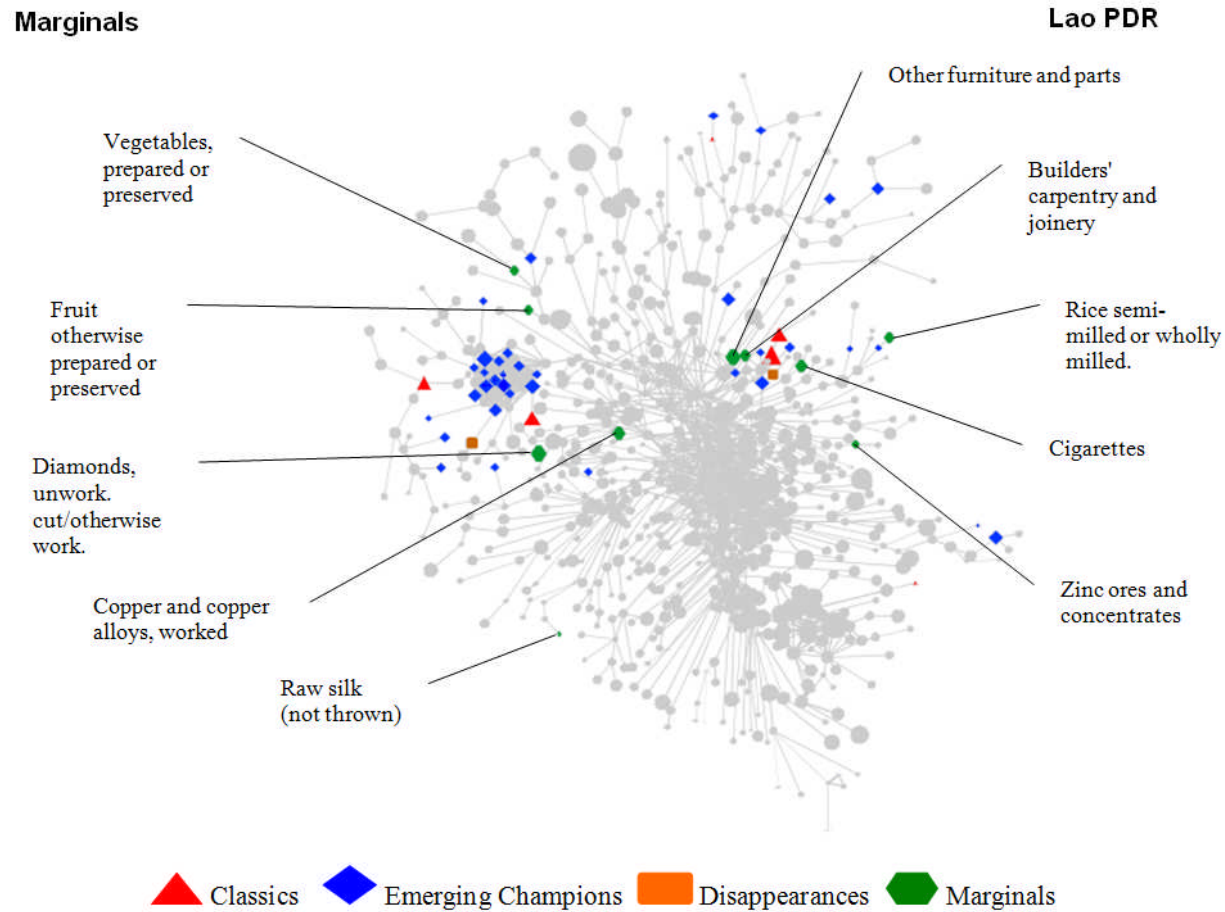
Source: Authors' estimates / Map generated using software by Hidalgo, et. al. (2007) available in <http://www.nd.edu/~networks/productspace/index.htm>

**Figure 12:** Product Space Map for the Lao PDR (emerging champions – zoomed in focus on garments)



Source: Authors' estimates / Map generated using software by Hidalgo, et. al. (2007) available in <http://www.nd.edu/~networks/productspace/index.htm>

**Figure 13:** Product Space Map for the Lao PDR (marginals/products where Lao exports are significant, but there is no comparative advantage)



Source: Authors' estimates / Map generated using software by Hidalgo, et. al. (2007) available in <http://www.nd.edu/~networks/productspace/index.htm>

## 6. Drawing Conclusions

### *What does the product space analysis tell us?*

Over the course of this paper we have used an analytical approach based on revealed comparative advantage and the product space to assess long-run trade performance and trends in the Lao PDR. The following is a short summary of the key points raised during the analysis.

Firstly it is clear that over recent years the Lao economy has become increasingly open and integrated with the regional economy. Exports as a share of GDP have grown as bilateral flows have opened up with a number of partners.

However, the Lao PDR is highly dependent on a limited range of export products to earn foreign exchange. Given already committed investments in new minerals and hydropower schemes, this share is set to grow. Projections suggest that the Lao exports will become even more undiversified if current trends are extrapolated over the next 10-15 years.

The rate of new product discovery has been high, with the number of major products exported by the Lao PDR growing strongly over recent years. Export discovery has also been strong in non-natural resource based products, but this growth has been outstripped by that in natural resourced based products. Thus while the country has made commendable efforts to move into new export products, this process has essentially been overshadowed by the natural resources export boom.

Analysis of the export basket of the Lao PDR shows that the income potential of currently exported products (PRODY) is low. In addition, since the 1997/98 Asian crisis, the sophistication of the Lao export basket has increased at a very slow rate, below that of regional peers. Lao export products are primarily located around the periphery of the product space, implying that there are few linkages between the current export basket and a wider range of products that might yield greater value addition in the future.

Similarly, the scope to redeploy institutional arrangements and factors of production currently deployed in the existing basket of export products into new products is limited (low path and density of existing export products). With few linkages between products located around the periphery of the product space, the Lao PDR will find it challenging to diversify further. International evidence suggests that high export concentration carries risks in terms of vulnerability to sector-specific shocks, shifts in terms of trade, losses in efficiency and resultant lower rates of economic growth.

Nevertheless, while the overall trend of income growth in export products and growth in the scope for diversification at the product level is poor, the fact that the Lao PDR is now exporting a wider range of products than in the past does suggest some grounds for optimism. The basic fact that a larger number of product categories are currently being exported increases the likelihood that a greater number of product discoveries will be made in the future. i.e. The Lao PDR now has more opportunities to diversify across the product space, even if the probabilities of diversification from each product are rather low. This might be interpreted as a first, and necessary, step towards a more diversified export basket.

However, given the clear challenges outlined above it is important for the Lao PDR to consider articulating a long term development vision that seeks to address the risks resulting from lack of diversification, and lack of incentives to invest in diversified products.

***What does this mean for the Lao policy maker?***

Based on the conclusions outlined above, our recommendations for an informed strategy for achieving sustained export diversification would comprise of the following:

- I. Ensure that the enabling environment provides the right incentives for all exporters. Private sector investors respond to incentives. Very high returns can help compensate investors for the costs of investing in an otherwise poor business environment. It may well be the case that the comparatively high returns (high net present value) from natural resource based investments are viable in a poor investment climate, while the returns to non natural resource based investments in a similarly poor investment climate are less clear given more uncertain returns and longer payback periods. Thus getting incentives right to support all exporters, including the future champions that have not yet been identified, is a policy prerequisite. Current evidence suggests that exporters in the Lao PDR continue to face a higher regulatory burden than non-exporters (World Bank 2010b). Thus a conducive regulatory environment which minimizes business environment transactions costs needs to be put in place which supports existing exporters (export survival), investment by new exporters, and the wider export discovery process (by both existing and new exporters). Macro-economic policies that provide greater incentives to exporting and adding value to domestic exports might also be considered. While the Government of the Lao PDR has made commendable efforts to improve the investment climate over recent years, this process needs to be accelerated and a specific emphasis given to improving the investment climate for exporters. The evidence also suggests that high value perishable agricultural products suffer disproportionately from high trade costs (and therefore respond more to interventions that improve trade facilitation).

If the government wishes to go further and attempt the delivery of targeted public goods to support specific sectors, then the following addition options may be considered.

- II. Provide targeted public goods (core infrastructure, research, productivity and skills training, assistance towards compliance with international standards etc..) to specific sectors as a means of stimulating accelerated growth. Such *sector level* policy might include efforts to achieve the following:
  - a. Sustain growth in the major emerging champion sectors that demonstrate high PRODY and Path.
  - b. Support possible future champion sectors with high PRODY and Path from the list of currently marginal products.

Since this analysis has been carried out at a broad macro level, it only provides approximate hints at possible products of interest. Further in-depth sector analysis would need to be undertaken before any intervention to deliver targeted public goods is considered.

- III. Ensure that investors in products with low value and limited scope for future diversification (low PRODY and Path) are not provided with preferential incentives. The analysis in this paper also reveals that some high growth export sectors have very limited income potential, or scope for movement into other export products with higher income potential. Unless there are strong social or

environment reasons for supporting accelerated growth in these sectors, government should be cautious in extending sector specific support or preferential treatment.

It is worth cautioning that sector level interventions carry inherent risks and at a minimum need to be carried out in an open and transparent manner and should not be aimed at individuals firms. Interventions to support one sector may result in unanticipated negative consequences in another sector. In addition, policymakers need to be mindful that focusing too much on specific identified sectors carries the risk of missing future champion sectors that have not yet emerged.

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