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Structural Constraints and Excess Capacity: An International Comparison of Manufacturing Firms

1. Introduction

Average capacity utilisation rates in productive sectors such as manufacturing vary from country to country and over time within each country. For example, the average excess capacity rate was around 40% in Bangladesh and Bolivia, 30% in Tajikistan, Albania and Cameroon, and over 20% in Indonesia and Nepal during 2005-7 (World Bank Enterprise Surveys). In-country variation over time is also significant.

Capacity underutilisation has two significant outcomes. First, idle resources in firms with low capacity utilisation have opportunity costs (i.e. foregone output) as well as real costs. Outlays for the repair and maintenance of excess capacity, rents for unused structures, and payment of debt that funded the purchase of such assets have to be maintained when firms lower their output level for various reasons in certain periods. Second, given adjustment is costly, subject to constraints and involve lags, high levels of idle capacity imply inefficient use of installed capital stock as well as workforce. This implies a negative impact on productivity of labour and capital and hence on international

competitiveness of the countries. The cost and productivity effects of excess capacity would lower growth of income both at macro and micro level.

While the literature contains ample studies on the measurement of capacity utilisation rate (Klein and Preston 1967, Nelson 1989, Corrado an Mattey 1997, Wen 1998) there is very limited work on its determinants. Given its costs, the investigation of the factors that cause capacity slack in productive sectors is important for policy making. This paper aims to focus on this inquiry in the context of manufacturing enterprises in developing countries. In particular, it tests the validity of the proposition that industrial capacity utilisation rates are influenced by structural constraints (especially on the supply as well as institutional side) in addition to demand and market structure effects. We use firm level data from 50 countries. The data are extracted from the World Bank Enterprise Surveys, conducted during 2009 and 2010.[1]

The paper is organized in the following way. The next section provides an outline of the determinants of capacity utilisation rates drawing upon the relevant literature. This is followed by an informal analysis of the links between structural factors and capacity utilisation rates. In Section 3 we develop a method of estimation to explain the levels of capacity utilisation rates on the basis of the conventional factors (business cycles and market structure) and the above mentioned structural variables. This is then used for regression analysis and the results are reported in the same section. Section 4 provides a summary of the overall conclusions of the paper.

[1] Access to data is through http://www.enterprisesurveys.org/

2. What are the determinants of capacity utilisation rates?

2.1.The conventional approach

Why do firms create greater capacity than what is justified by demand level? Various explanations exist in the literature of which one strand is related to the influence of technological factors on capacity utilisation levels. Even under the conditions of an unrealistic scenario with no uncertainty and unchanging demand, a precise match between capacity and demand is unlikely due to investment indivisibility (Brems 1964, Minasian 1979). Some firms may prefer to operate at full capacity with unmet demand while others may choose to operate with idle capacity (caused by investment indivisibility) to fully meet the demand if that is a profitable option. Irreversibility of investment is another factor with similar consequences (Cabellero and Pindyck 1996). Introduction of technologically advanced machinery and equipment may also impact capacity use. For instance, a study by Bansak *et al.* (2007) indicates that technological change during 1974-2000 lowered capacity utilisation by 0.2-2.3 percentage points.

A more prominent explanation is offered by macroeconomic studies in which variation in capacity utilisation rates is caused by the fluctuations in output resulting from business cycles. Decline during economic downturn takes the form of underutilized workforce or capital stock or both (Basu 1996, Basu et al. 2001, Bils and Cho 1994, Burnside and Eichenbaum 1996, Fagnart *et al*. 1999, Shaikh and Moudud 2004) while in the expansionary phases of the cycles, firms move towards full capacity utilisation. Winston (1974) considers this as unintended or ex-post excess capacity, resulting from uncertainty about the size of expansion during the upturn and contraction in the downturn. The cycles

may affect firms' use of capacity through changes in demand for their products or through changes in the prices of inputs they use in the production process. It is this observed relationship that has led capacity utilisation rate to be used as an indicator of the inflationary or deflationary tendencies by policy makers, including the Federal Reserve in the US, Bank of Italy and Bank of Canada. A considerable body of research exists on the links between inflation and capacity utilisation rates (Garner 1994, Mustafa and Rahman 1995, Parigi and Siviero 2001, Arestis and Sawyer 2005).

Another strand of the literature suggests that excess capacity is associated with market structure. This approach involves a microeconomic focus in which excess capacity is studied as an indicator of imperfect competition or as a device of entry barrier. Firms create greater capacity than necessary to deter new entry to the market (Chamberlain 1933, Cassels 1937, Rothbard 1964, Barzel 1970, Wenders 1971, Spence 1977, Dixit 1979, Hilke 1984, Margolis 1985). This is viewed as strategically useful idle capacity (Robles 2011) or intended, ex-ante idle capacity (Winston 1974) which helps incumbent firms to retain their market share.

2.2.Deviant observations

The views outlined above do not explain a particular peculiarity in some countries where industrial capacity utilisation rates are persistently lower irrespective of the demand patterns, market structure or the attributes of investment. For example, in Sudan, at least 55 % of installed industrial capacity remained idle from 1985 to 1997 except for sugar and leather industries (Dagdeviren and Mahran 2010). In fact, the sectors with a greater capacity utilisation rate than average were those where market concentration was greater,

a finding that seems to contradict the view that excess capacity may be an instrument of entry barrier. More evidence on the long-term presence of excess capacity in other African countries can be found in Mazumdar and Mazaheri (2003) which shows that these rates remained around 55–60 % during the 1990s in many African economies.

As the enterprise surveys do not provide us with time series data we are unable to demonstrate the persistence of excess capacity at firm level in this paper. However, we can show that some regions and country groups have a greater proportion of their firms in the manufacturing sector with much higher excess capacity levels than others. Let us assume for the purpose of comparison that firms with 40 % or more idle capacity could be considered to have severe capacity slack. While this classification may appear arbitrary, it is based on the view that installed capacity is unlikely to precisely match current demand due to factors like investment indivisibility, irreversibility and uncertainty about growth of future demand. In fact, the data for the whole sample of countries used in this study with over ten thousand firms show that only around 20 % of all companies operate at almost full-capacity (i.e. with less than 5 % excess capacity). A firm-level excess capacity of up to 25 % could be regarded as normal. Assuming that there may be further ups and downs in the normal excess capacity rate due to fluctuations in demand, an idle capacity of 40 % or more could be regarded as severe underutilisation of firms' resources.

Table 1 below presents the proportion of firms according to this categorization by four regions and three income groups. It shows that more than a quarter of the firms in the whole sample suffer from severe idle capacity. The 8 African economies have the

greatest share of the firms with severe capacity underutilisation. This is followed by the South American, East European firms and the Asian firms.

On the other hand, and perhaps more interestingly, when countries are grouped according to their income status it is clear that the proportion of firms with severe excess capacity is greatest in the group of low income economies and lowest in the upper middle income countries.[2] Although the low income Asian economies do not seem to be fitting into this categorisation, the number of countries is too small to make a conclusive judgement about it. A comparative study between Asia and Africa in this respect would be useful although it is beyond the scope of this paper.

[Table 1. Incidence of severe excess capacity rates (%)]

To check the relationship between capacity and trade cycle effect, we added the data on the average growth in sales in the last column. One may crudely indicate that there is no systematic association between differences in the growth of sales and severe excess capacity rates. For example, firms in low income countries experienced the highest growth in sales but they also have the highest severe idle capacity rates. One of the questions is the extent to which the sales data were affected by the Great Recession following the 2008 financial crisis. The majority of the surveys included in this study report data for 2007. However in South America the survey data is for 2009 and here the

[2] We used World Bank's Method in the classification of countries by income status. Countries with less than 1006 USD per capita gross national income –estimated by Atlas method– are classified as low income, those with 1006-3975 USD per capita as lower middle income, and those with 3976-12275 USD as upper middle income countries.

regional sales on average do not seem to have been affected by the Great Recession in that year.

[Figure 1: Capacity use and per capita income (50 countries, 2007-9)]

The relationship between the level of development and capacity use is further reinforced by Figure 1 above where the data on the prevalence of severe excess capacity are plotted against per capita income levels. There is a clear negative relationship between the two data series in the graph where higher income levels are associated with a lower incidence of severe idle capacity.

2.3. Why would supply-side, political and institutional context matter for capacity utilisation?

What explains the observations discussed above? Why do firms in low income economies on average have a greater incidence of operating with severe idle capacity? One argument is that per capita income levels act as a proxy for other factors associated with the level of development. It is possible that industrial capacity utilisation, especially in the developing world, is partly dependent on some structural factors including the supply side conditions and institutional environment within which firms operate (Dagdeviren and Mahran 2010, Rand and Tarp 2002). Supply side factors include the quality and continuity of utility services such as water, electricity and telecommunications, state of infrastructure including road and transport networks and availability and conditions of access to credit. If any of these factors are essential for the production and marketing of output, permanent lack of access to these services and networks is likely to hinder the start-up of productive

establishments rather than cause capacity underutilisation. It is when firms have discontinuous or intermittent access to essential utilities and infrastructure that their capacity use would be affected either through a direct or indirect impact on production, orders and deliveries. Disruptions in transport networks could affect delivery of inputs or outputs. Flow of inputs, to especially agro industries, can be affected by climatic fluctuations. Power outages in the absence of remedial measures (for example, generators) can bring the production process to a halt. Problems in telecom facilities can slow down the orders and hence flow of raw and intermediate goods as well as the sale and delivery of outputs. If firms rely on credit for working capital, episodic disruptions to or delays in the flow of finance can also impact the level of capacity utilisation.

Indeed, there is considerable literature on how these types of supply side factors may influence enterprise performance in the developing countries. Many studies examined the relationship between some productivity or output variable and the supply side constraints. For example, Yeaple and Golub (2007) show the impact of the availability (or lack) of physical infrastructure on total factor productivity. A similar evaluation on the importance of the infrastructure for industrial development could be found in Yumkella and Vinanchiarachi (2003). Tribe (2000) and Rattsø and Torvik (2003) discuss the effect of foreign exchange shortages for poor manufacturing performance. Lawrence (2005) and Bigsten and Söderbom (2005) highlight credit constraints amongst other problems. Disruptions in the flow of and problems in access to raw and intermediate production goods is considered as a major growth barrier by Cramer (1999) and Sleuwaegen and Goedhuys (2003).

Similarly, institutional defects and political instability can cause disruptions of various durations in the production process. Clearly, firms can develop different strategies to deal with institutional adversities. In the extreme and persistent cases, such adversities would result in exits from the sector. Dagdeviren and Mahran (2010) show how political conflict and civil war in what is now South Sudan has led to the disappearance of most manufacturing activities. Under less extreme conditions social conflicts resulting in, for example, civil disorder and industrial strikes may lower the use of existing productive capacities. The impact of such political instability on production has been discussed in more detail by a number of studies in the literature, including Lall (1995, 1998) and Collier (2000, 2008).

Capacity and efficiency problems in public administration can also hinder an important role for obstructing smooth operation of productive units. Excessive delays caused by ineffective administration of import procedures at ports are well known for their adverse impact on the flow of inputs which would affect capacity utilisation of firms. Ineffective law enforcement, resulting in corruption, crime and theft, can enrich some but increase the cost of production for firms and obstruct their operations. This is shown by Malik and Temple (2009) who studied the problems in law enforcement and their impact on output volatility.

With these issues in mind, we develop a framework of analysis in the next section in order to test the validity of the argument that supply-side factors and institutional structure matter for the levels of capacity utilisation in addition to market structure and demand patterns.

3. Determinants of capacity utilisation rates: the method of estimation and data

The observed, widespread variation in capacity utilisation rates is likely to be an inherent part of the production process, implying that the relevant analysis has to move beyond the frameworks of full-employment level of output. A useful way forward may be to achieve some conceptual clarity. The most frequently employed definition of capacity utilisation rate is its expression in terms of output, more specifically, the ratio of actual output to potential output. However, what constitutes potential output and what processes are involved in the movement from actual to potential output is not always straight forward. First of all, there is the time dimension of capacity utilisation rate. Intensive work practices beyond customary and/or standard work hours –for example, using night shifts– may allow firms to increase capacity utilisation rate and even exceed the potential output level. Planned and unplanned downtime and availability of parts and necessary engineering skills would also affect the time use of installed capacity. In empirical studies involving developing countries, details of time use of production facilities are usually not available. Hence, most researchers use a capacity utilisation measures expressed in terms of output.

In this study, we propose four output terms. The first is *maximum potential output* which is determined by the installed production capacity. Maximum potential output is not necessarily equal to full employment level of output in that it includes capacity installed to deter entry to market and maintain market power. The cause of this type of excess capacity which we may call intended idle capacity –following Winston (1971)– is different from 'unintended excess capacity'. Alternatively, firms can economize on capital stock for greater efficiency in circumstances where market conditions are

competitive and do not allow significant market power to any individual firm. In other words, idle capital installed as barrier to market entry can be zero in fully competitive conditions or a positive sum where there is some degree of market concentration. The presence of this type of excess capacity may not affect the utilisation of labour force unless there is an increase in demand that leads firms to draw on idle capital stock. Second, maximum potential output must be distinguished from *feasible output*. We use the latter concept to highlight circumstances in which a desired level of output (i.e. given demand) cannot be achieved because of the factors outside the control of firms or what we called previously as structural constraints (like the prevalence of power cuts, or disruptions in the flow of inputs because of infrastructural failures). Unlike market imperfections, structural constraints are likely have an impact on both the use of capital and labour and hence on the overall capacity utilisation rate.

While the distinction between the terms of maximum and feasible output crucially hinge upon the role of structural factors, the literature furnishes us with plenty of evidence that demand side factors do also have considerable influence on the determination of capacity utilisation rates. Myriad influences, including changes in household incomes and relative prices of goods and services, could be considered in this respect. But for the purposes of this study, we will focus on sales at firm level to reflect the effects of the demand side. Consequently, we also distinguish maximum and feasible output from *actual supply* which is determined by firms' expectations about the level of demand. Furthermore, actual supply (or sales) is different from actual production in that the latter may include additions to inventories while the former may involve withdrawal from it. In other words, the imbalance between actual production and actual supply either leads to depletion or

accumulation of net inventories. However, for the purposes of this study, we focused on actual supply and did not include inventories in the analysis.

Overall, we propose that the divergence of actual supply from the maximum potential production level depends on the level of demand (*D*), market structure (*M*) and the constraints imposed by the structural conditions (*SC*). Assuming that *M* and *SC* are measurable, and actual production and maximum potential output are denoted by (Q_r) and (Q_{mx}), respectively, firm level capacity utilisation rate can be measured as:

[1] $CU_i = \frac{Q_{ri}}{Q_{mxi}}$

where *i* is an identity number for individual firms and it varies from 1 to *k*. The difference between actual and maximum production, and hence CU, is described as a function of *D*, *M* and *SC*.

[2] $CU_i = F\ (D_i, M_i, SC_i)$

For regression estimations, we used a general linear model suitable for Ordinary Least Squares.

[3] $Y_i = \alpha + \beta_j \Sigma X_{ij} + \mu_i$

Where *Y* represents the dependent variable, *X* the independent variables, j is the number of explanatory variables in the equation, α is the constant, β's are the estimated

parameters on explanatory variables and μ is the error term. Adapting [3] for the CU function in equation [2], we obtain:

[4] $CU_i = \alpha + \beta_1 S_i + \beta_2 M_i + \beta_3 SC_i + \mu_i$

Sales (S) are expected to be positively related to capacity utilisation rate with a positive parameter (**β_1**). The sign of the parameter β_2 , on the other hand, is expected to be indeterminate. A negative sign could be reflecting the effect of uncertainty and lack of coordination in the creation of new capacities when the degree of competition is higher, resulting in lower capacity utilisation. A positive sign would indicate that excess capacity is used as a barrier for new entrants and that greater competition reduces the tendency for higher excess capacity. The coefficient of the structural constraints is anticipated to have a negative sign.

3.1.Data and Estimations

In this study, we used the World Bank's Enterprise Surveys published in the years 2009 and 2010 for a total of 50 countries, consisting of 16 low income, 18 lower middle income and 16 upper middle income countries. Surveys published in 2009, reflect the data for 2007 and those published in 2010 report data for 2009. Of these, 5 are from Asia, 8 from sub Saharan Africa, 18 from South America and 19 from Eastern Europe and Central Asia. The questionnaires contain around 200 questions on sales and performance, innovation and competition, capacity, infrastructure, finance, labour, corruption, public administration and political stability. The number of firms included in the surveys varies from country to country depending on the size of the economy and the manufacturing

sector in each country. The surveys across the countries contain identical questions on variables that are of interest to this study.

The capacity utilisation rate (*CU*) in this paper is based on the responses given by enterprises to the following question: what was this establishment's actual output as a proportion of the maximum output possible if using all facilities available? The variable *M* is included to capture the effects of market structure on the capacity utilisation rate and the degree to which excess capacity is used as an entry barrier in more concentrated markets. The data for M is based on the scorecard figures that represent the degree of competition firms face and it varies from 1 to 4, with 1 reflecting a monopolist stance in the market, 2 is for an oligopolist, 3 for a relatively less concentrated market structure and 4 for competitive conditions. The effects of demand (*S)* on capacity utilisation rate are captured by the sales of firms, which we deflated using the USD constant price index of the World Development Indicators to ensure cross country comparability of the data.

The structural constraints (denoted by *SC* in equation 4) are divided into the supply side (*SSI*) and institutional constraints (*II*) in empirical estimations to distinguish their impact on *CU*. SSI is estimated as a composite index based on the average of scorecard responses given by the surveyed firms on the extent to which each of the following constituted an obstacle for their operations: electricity, telecom, finance, labour regulations and inadequately educated workforce. The scorecard figures range from 0 (reflecting no obstacle) to 4 (representing a severe obstacle). Similarly, the institutional constraints are represented by a combined index (II), estimated as the average of the scorecard figures given by the firms on five factors: political instability; corruption; crime, theft and disorder; licencing and permits; and tax administration. Once again, if

any of these elements present a severe barrier for firms the score is 4 which descends to 3, 2, 1, 0 to reflect major, moderate, minor and no obstacle conditions, respectively.

A number of caveats are in order here. First of all, composite indices are constructed assuming that each constraint has equal weight in influencing capacity utilisation rates. In reality, it is likely that one element of these indices (say, interruptions in power supply) has a different level of impact on excess capacity than another element (for instance, labour regulations for hiring and firing workers). Secondly, the scorecard figures reflect the perceptions of the respondents. Their comparative value in reflecting the supply side and political constraints may not be as precise and objective as desired. This is especially true for cross country estimations where all countries with different development levels are included in the same sample. For example, a constraint that is perceived as moderate in Burkina Faso may be scored as severe in Argentina since firms' perceptions about the quality of things are likely to be influenced by locally or nationally accustomed and expected standards rather than international standards. Therefore, in estimations involving the full sample, the SSI and II data are weighted by the per capita incomes of each country. When the absolute income figures are used in the adjustment of indices, they dominate the index numbers. In order to avoid this, we used log-scaled ratios of the per capita incomes of individual countries to that of the richest country in the sample. For estimations involving samples of countries classified by their income status no such adjustment has been made to the indices.

Moreover, our data is unbalanced in two ways. First, although the data sets from fifty countries altogether contain over ten thousand observations on firms' sales, capacity utilisation etc. there are missing data for some firms and variables in every data set.

Secondly, as mentioned above, the sample size differs widely depending on the size of the manufacturing industry in individual countries. For example, the sample for Brazil contains over 1300 firms, for Vietnam over 700 firms, while that for Angola and Mongolia contains around 150 firms. Hence, regression estimations without any adjustment to the data sets produce results that reflect the tendencies in the countries with the greater sample size. To tackle this issue, we carried out and presented the estimations for both the unbalanced and full samples as well as the balanced and adjusted samples. In the latter, the maximum sample size for each country has been limited to 200 firms. We used random selection method in the construction of subsamples for countries where datasets included more than 200 firms. Furthermore, the reduced balanced data contain only the firms with full information on all variables. Performing estimations on two different data sets should enable us to check the robustness of the results as well.

Equation [4] has been used for empirical estimations. The preliminary analyses have been carried out with the Ordinary Least Squares method but these revealed heteroscedasticity which is common in cross sectional estimations. There are various methods to deal with this problem. For example, removing the outliers in the data set can provide a solution but this leads to loss of data. Initially, we used a variant of Weighted Least Squares Method to achieve constant residual variance. Nevertheless, this method, too, resulted in significant data attrition in our unbalanced data sets which in some cases made estimation impossible due to an insufficient number of observations. A similar method is known as the Robust Regression estimation which deals with heteroscedasticity in data sets with outlying observations. Our estimations are based on a variety of the Robust Regression Method that is available in STATA and this has eliminated heteroscedasticity without substantial attrition in the data. The method uses Cook's distance estimate to eliminate

extreme outliers and then enters into an iterative double weighting process, involving Huber weights and biweighting where observations with greater residuals receive smaller weights.

We can presume that equation [4] does not involve considerable endogeneity. All variables on the right hand side of the equation are likely to be exogenous. That is, demand, supply side conditions and institutional structure could be treated as given. There might be a degree of endogeneity between capacity utilisation and market structure if idle capacity is used as an entry barrier. However, even then there are other stronger exogenous causes of market structure (such as licencing and government policy, and technological factors for sectors as in natural monopolies which require sunk-investment costs).

[Table 2. The correlation matrix of variables used in regression estimations]

Moreover, as the correlation matrix in Table 2 above suggests, most variables are largely unrelated to capacity utilisation rates. There is a considerable degree of positive correlation between the institutional index and supply side index but this is expected since we separated them purposefully to measure their individual impact on the use of capacity.

3.2.Results

The first set of results in Table 3 provides the findings obtained from the unbalanced full data set. Recall that there are wide deviations in terms of the size of the country samples

in this data. Hence, the parameters may reflect the underlying tendencies in large datasets (for example, those for Brazil, Argentina, Vietnam and Indonesia) than those for smaller data sets (such as Mali, Yemen, Costa Rica and Angola). The advantage of the results from the unbalanced database is that they are likely to reflect the overall group dynamics better since countries with large data sets tend to have larger manufacturing industries and therefore it may be appropriate for them to have greater weight in the determination of relevant parameters.

Table 3 reports two different sets of coefficients for each country group. The first set reflects the estimates obtained from original estimations which contained variables expressed in different units. Sales are expressed in constant monetary value and in logarithmic form. Market structure reflects scorecard figures and supply side and institutional constraints are measured as composite indices. Differences in units with which the data are expressed hinder comparison of the impact of different variables. To overcome this, we reported Beta Coefficients[3] in addition to the original coefficients. F statistics are reported to demonstrate the overall significance of all variables and their coefficients.

[3] Beta coefficients are estimates based on datasets in which observations are transformed using the following: $y_{ij} = (Yij - \dot{y}_j) / SDj$ where y is the observation for firm i on variable j, $\dot{y}$ is its mean and SD is its standard deviation

Most of the findings are in line with our expectations. The coefficients on the sales variable indicate that the level of demand exerts a statistically significant and positive impact on firms' capacity utilisation rate, irrespective of the income status of the groups.

[Table 3. Robust Regression Estimations (Unbalanced Full Sample)]

The results on market structure, on the other hand, are less straightforward to interpret. The coefficients on market structure are statistically significant only for the Upper Middle Income group as well as for the whole sample. It is likely that the significance in the whole sample reflects the influence of the Upper Middle Income group. This tendency may be strengthened further with the contrasting impacts of market structure on capacity utilisation rates in Low Income and Lower Middle Income groups that are likely to have negated each other. Moreover, if excess capacity were used as a tool for entry barrier then the sign of the parameter for market structure would have been positive, reflecting the tendency for firms in less competitive markets (with scorecard figures 1 or 2) to have lower capacity utilisation. However, the sign on the coefficients of market structure are negative for most of our estimates except for the lower middle income group. In other words, greater competition results in lower capacity utilisation in all groups except lower middle income category. In cases where the parameters are significant (upper middle income countries and the full sample) this might be considered as the excess capacity creation through uncoordinated enterprise development in relatively more competitive markets.

The findings with respect to the impact of structural constraints on capacity utilisation are more interesting and broadly confirm our proposition. There is clear evidence that the influence of supply-side and institutional constraints vary with the level of development. In low income countries, both of these factors seem to exert a significant negative impact on capacity utilisation rates. For example, the results imply that a one score reduction in structural constraints from being 'severe' to 'major' would lower excess capacity rates by around six % in the low income countries. More crucially, the Beta Coefficients in Table 3 show that the combined effect of supply-side and institutional constraints is around five times greater than the impact of the demand variable on its own. The same is also true for the estimates related to the whole sample, although the scale of difference between the parameters of structural factors and the demand variable is not as large as it is for low income economies.

The estimated parameters also show that as the level of development increases the impact of structural factors for the determination of excess capacity either diminishes or becomes statistically insignificant. Hence, in lower middle income countries supply side constraints are no longer significant while institutional problems continue to play an important role for the use of installed capacities. In the upper middle income countries on the other hand, neither the supply side nor the institutional problems seem to have relevance for the capacity utilisation rates.

Table 4 shows the results from the balanced data set. As mentioned previously, this data set contains all observations from the countries with less than two hundred firms in the surveys and a subsample of the observations for countries where more than two hundred firms were surveyed. The subsamples have been created on the basis of random selection

and the sample size has been limited to two hundred firms. The advantage of the balanced sample in this exercise is that it prevents the domination of estimates by the tendencies in large data sets and allows the dynamics of countries with smaller manufacturing sectors to equally influence the estimations.

The results in this table are not wildly dissimilar from those reported in the previous table. The level of sales once again wields a positive and significant impact on capacity utilisation in all country groups. A comparison of the size of the original coefficients implies that its impact is greater in the balanced sample. The findings with respect to the role of the supply-side and institutional factors are broadly similar in that both play an important negative role in the determination of capacity utilisation rates for the all-country-sample. At the level of subsamples, their impact varies according to the income status of the country categories. In low income countries, the influence of the structural constraints is twice greater than that of the demand variable. As we move down to lower and upper middle income country groups their effect wanes.

[Table 4. Robust Regression Estimations (Reduced Balanced Sample)]

There are a number of distinct results in Table 4 in comparison to Table 3. Firstly, capacity utilisation rates in the upper middle income group of the balanced sample are entirely dependent on the level of sales. No other factor seems to have any significant role to play in this respect. This implies that when the influence of the large players in manufacturing is suppressed to some extent, the level of sales is the most important factor in reducing excess capacity rates on average. Secondly, the coefficient of market structure is now statistically insignificant throughout, suggesting that in countries with

relatively larger manufacturing sectors uncoordinated expansion in the manufacturing sector may lead to greater idle capacity. Finally, in the lower middle income group with 18 countries, a substantial reduction in the size of surveys of only three countries (i.e. the Philippines, Peru and Colombia) led to a shift in the relative importance of the supply-side and institutional factors. Whereas in the full sample the institutional factors were found to be significant, in the reduced balanced sample supply side-constraints seem to play greater role in lowering capacity utilisation rates.

The most important overall finding, confirming our initial proposition in this paper, is that structural factors in the form of supply-side constraints and institutional failures do play an important role for the effective use of installed productive capacities in the manufacturing sector of the lower income economies.

3.1.Policy implications of findings

Intuitively, it may be plausible that the efficient use of productive capacity depends not only on firm specific factors but also on structural features of the economy. However, unless this is told and demonstrated, academic discourse may continue to rely on conventional explanations. In fact, sometimes the standard theory may prevail despite rigorous theoretical alternatives and empirical evidence.[4]

[4] Consider the assumption of 'rationality' in the mainstream economic theory. We have known intuitively that economic decisions are not always the result of 'rational thinking' and this was shown theoretically by Henri Simons in the 1950s and by many others later. And yet, the assumption of rationality continued to play a key role in the economic literature,

The discussion and results of our estimations above have important implications for industrial policy in the middle and low income economies. The number of business start-ups is usually lower in these economies. But even the firms that do start up operate under considerable constraints. Moreover, firm level efficiency is not only about implementing the most suitable organisational and engineering technique but also improving the conditions within the broader environment in which firms operate.

The data in Table 5 provide some evidence –although not exhaustive– on some of the structural factors discussed so far. It shows that the poorest countries' educational attainments are around one-third, access to electricity is two-thirds, and access to telecom facilities is one-twentieth lower than higher income countries. Connections to the power network take more than 5 months on average in the low income regions. For half of the businesses in the low income countries, it takes a minimum of nine days to import inputs and equipment and export their outputs while in richer countries it takes around 3 days. The number of borrowers per 1000 population is a mere 14 in the former group and 225 in the latter.

[Table 5. Various structural constraints by region and income group]

These examples only provide a small glimpse into the real challenges firms may be facing in low and middle income countries. At a broader level, a number of areas could be highlighted for policy interventions. Firstly, extension of infrastructure and utility networks would play an important role in maximizing production capacity as well as expediting transactions of trade. These include transport systems by road, rail, maritime and air, information systems and telecommunications networks, energy and water

networks. Secondly, improvements in the public administrations that sanction, monitor and enforce transactions of firms (e.g. procedures for access to essential inputs such as imports, foreign exchange and utility networks) would be crucial for reducing disruptions to production and trade. Thirdly, it is widely accepted that better access to finance can be important for the smooth running of existing production units but it would also increase the number of start-up firms.

4. Conclusions

Causes of excess capacity have been an under-researched despite its crucial importance for productivity and competitiveness. This paper has focused on this topic in the context of an international comparative study of manufacturing firms. We have argued that the standard explanations, especially those related to trade cycles and market structure, may not fully explain the behaviour of capacity utilisation rates. Instead, we have proposed that structural factors associated with supply-side constraints and institutional deficiencies may partly be responsible for greater capacity slack in lower income economies.

Our analysis is based on data sets extracted from the Enterprise Surveys carried out by the World Bank during 2009 and 2010. The sample included 50 countries, mostly from the developing world. Classifying firms by the level of their capacity utilisation rates, we found that only 20 % of firms in the whole sample operated close to full capacity while the incidence of severe excess capacity rates was around 30 %. More importantly, our estimations revealed an association between the level of development and the average capacity utilisation rates, in that severe capacity slack is shown to be greater in the low

income countries in comparison to the middle and upper middle income countries. These differences do not appear to be directly related to variation in the growth of demand across countries in different regions and income groups.

The results from the econometric estimations provide strong support for the proposition that the failures on the supply side and institutional environment have a sizeable impact on the effective use of firms' productive capacities. This overall significant impact varies with countries' levels of development. In the low income countries structural constraints have greater impact than any other variable while in the upper middle income countries they exert no significant influence. In the lower middle income countries on the other hand, supply side constraints appear to be more important for the use of capacity than institutional factors when sample sizes of country surveys are equalised across the countries. However, the results from the unbalanced data set, reflecting the tendencies of the countries with greater sample sizes, show institutional factors to be more significant for the effective use of productive capacity.

Overall, the findings in this paper have crucial implications for industrial policy. They suggest that there are gains to be made in the manufacturing industries of the lower income countries through improvements in the supply-side conditions as well as in their institutional environment. Better infrastructure services such as transport, electricity, telecom and water, improved access to finance, enhancement of skills and educational coverage are some areas where industrial policy may target to reduce the inefficient use of productive capacities. Reduction in destabilizing social conflicts, corruption, crime and

disorder as well as improvements in the operation of public bureaus would also contribute to smooth operation of the manufacturing firms.

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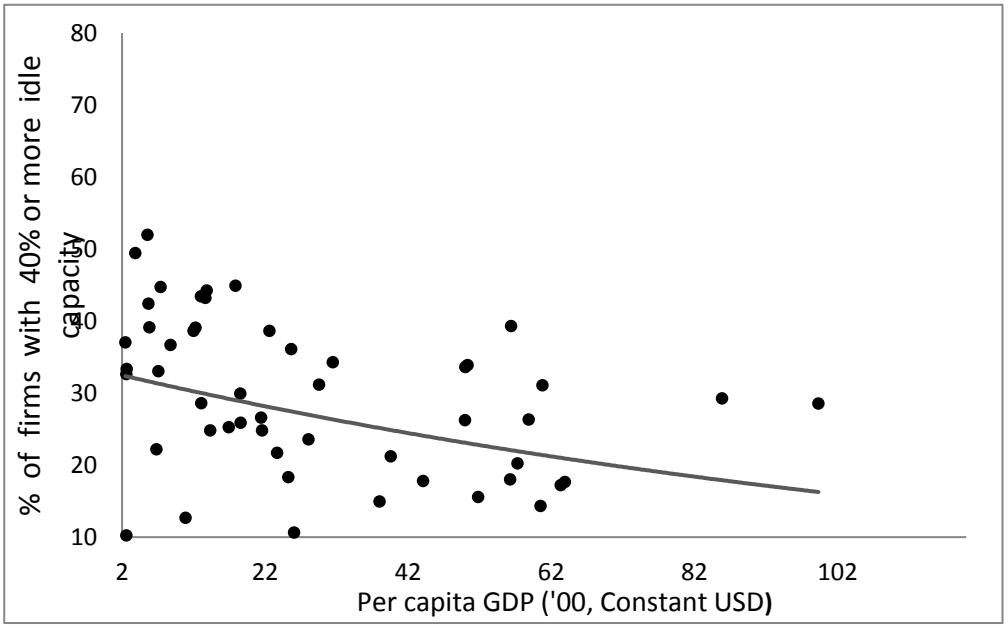
Table 1. Incidence of severe excess capacity rates (%)

	% of firms with ≥40% idle capacity	Growth of Sales (*)
All 50 countries (>10000 firms)	26.7	8
5 Asian countries (>3000 firms)	21.6	13
19 East Euro & Central Asian countries (>2000 firms)	25.9	32
18 South American countries (>5000 firms)	29.1	17
8 African countries (>800 firms)	34	26
16 Low Income countries (>2500 firms)	34	34
18 Middle Income countries (>3000 firms)	29.1	11
16 Upper-mid income countries (>4500 firms)	24	13

Source: Author's estimations, based on Enterprise Surveys data of the World Bank.
(*) For Asian, African, East European and Central Asian countries the growth rate reflects the 2004-7 average, for South American countries the 2007-9 average. The data by income groups and the total sample reflect the average of the two sample periods.

Figure 1: Capacity use and per capita income (50 countries, 2007-9)]



Source: Author's estimations.

Table 2. The correlation matrix of variables used in regression estimations

No of obs: 10259	Capacity Utilisation Rate	Sales	Institutional Index	Supply-side Index	Market Structure
Capacity Utilisation Rate	1				
Sales	0.0964	1			
Institutional Index	-0.0465	0.1082	1		
Supply-side Index	-0.0586	0.0319	0.5876	1	
Market Structure	-0.0026	-0.0043	0.0466	0.0169	1

Table 3. Robust Regression Estimations (Unbalanced Full Sample)

Dependent Variable: Capacity Utilisation Rate		*Independent Variables*				
		Log of Sales	Market Structure	Supply Side Index	Institutional Index	Constant
All 50 countries No of Obs: 10259 F Statistic: 27.0	Original Coefficients	0.57	-0.64	-0.82	-1.04	7.4
	Beta Coefficients	0.07	-0.02	-0.04	-0.05	
	T-statistics	6.79	-2.45	-3.21	-3.95	
16 Low Income Countries No of Obs: 2506 F Statistic: 33.7	Original Coefficients	0.39	-0.21	-3.90	-1.84	8.1
	Beta Coefficients	0.05	-0.008	-0.18	-0.08	
	T-statistics	2.26	-0.38*	-6.34	-2.80	2.8
18 Lower Middle Income Countries No of Obs: 3231 F Statistic: 15.8	Original Coefficients	1.04	0.23	-0.57	-1.86	6.3
	Beta Coefficients	0.12	0.009	-0.03	-0.08	
	T-statistics	6.19	0.48*	-1.21*	-3.61	2.2
16 Upper Middle Income Countries No of Obs: 4522 F Statistic: 12.5	Original Coefficients	0.62	-1.67	-0.45	-0.45	7.2
	Beta Coefficients	0.07	-0.06	0.02	0.02	
	T-statistics	5.01	-4.53	1.31*	1.27*	

Note: An asterisk (*) indicates that the respective coefficient is statistically insignificant.

Table 4. Robust Regression Estimations (Reduced Balanced Sample)

Dependent Variable Capacity Utilisation Rate		*Independent Variables* Log of Sales	Market Structure	Supply-side Index	Institutional Index	Constant
	Original Coefficients	0.88	0.02	-1.01	-1.29	6.6
All 50 countries No of Obs: 4836	Beta Coefficients	0.08	0.000	-0.04	-0.05	
F Statistic: 15.6	T-statistics	5.84	0.05*	-2.47	-2.88	2.8
	Original Coefficients	0.98	0.7	-1.94	-2.51	6.8
16 Low Income Countries No of Obs:1327	Beta Coefficients	0.09	0.03	-0.08	-0.10	
F Statistic: 14.4	T-statistics	3.29	0.80*	'-2.00	-2.28	4.9
	Original Coefficients	1.08	1.11	-1.41	-1.03	5.9
18 Lower Middle Income Countries No of Obs: 1591	Beta Coefficients	0.10	0.04	-0.06	-0.04	
F Statistic: 7.2	T-statistics	3.88	1.49*	-1.89	-1.32*	2.9
	Original Coefficients	0.81	-1.07	-0.67	-0.90	6.9
16 Upper Middle Income Countries No of Obs: 1518	Beta Coefficients	0.08	-0.04	-0.03	-0.03	
F Statistic: 6.9	T-statistics	2.9	-1.62*	-1.06*	-1.28*	5.6

Note: An asterisk (*) indicates that the respective coefficient is statistically insignificant.

Table 5. Various structural constraints by region and income group

	Upper middle income	Lower middle income	Low income	East Asia & Pacific	Europe-Central Asia	LAC	MENA	SSA
Adult Literacy rate (% of 15+)	93.6	70.6	61.2	94.7	98.9	91.5	79.2	59.8
Access to electricity (% of population)	98.2	72.9	32.9	92.0	..	94.9	95.0	34.9
Fixed internet subscribers (per 100 people)	10.8	1.4	0.2	11.7	21.1	8.3	4.0	0.2
Telephone lines (per 100 people)	19.4	5.4	1.0	20.9	35.7	17.9	16.9	1.2
Days required to get electricity	102.6	109.1	161.5	93.6	121.0	64.1	88.6	141.5
Days to export (import), median	3.3 (4.9)	4.5 (7.4)	9.4 (11.9)	2.3 (2.4)	2.4 (3.9)	4.5 (4.9)	2.8 (5.3)	9.3 (12.9)
Borrowers from banks (per 1,000 adults)	225.8	54.8	14.4	..	..	225.8	173.0	21.3

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