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Abstract

The informal sector is perceived as a buffer in crisis times in developing countries. Yet, it is generally characterized by low wages and high vulnerability. This paper explores how wages of informal workers react in the wake of a trade shock, with a special focus on the Egyptian case. To do so, we use worker and industry-level data for the tradeable sector from the Egyptian labor market panel survey between 1998 and 2006, a period during which Egypt experienced a significant trade liberalization wave. We find a significant effect on the formality wage premium where a 1-percentage point reduction in trade protection leads to 0.45 percentage points rise, on average, in the wage differential between formal and informal workers. The effect holds under different specifications and when the exogeneity assumption of industry protection is relaxed.

Keywords: Trade reform; labor market; informal jobs; wage differentials.
JEL Classifications: F16; J46; J31.

ملخص

يُنظر إلى القطاع غير الرسمي باعتباره حاجزاً في أوقات الأزمات في البلدان النامية. ومع ذلك، فهي تتميز عمومًا بانخفاض الأجور وارتفاع مستوى الضعف. تستكشف هذه الورقة كيفية تفاعل أجور العمال غير الرسميين في أعقاب الصدمة التجارية، مع التركيز بشكل خاص على الحالة المصرية. وللقيام بذلك، نستخدم البيانات على مستوى العمال والصناعة للقطاع القابل للتداول من المسح التتبعي لسوق العمل في مصر بين عامي 1998 و2006، وهي الفترة التي شهدت خلالها مصر موجة كبيرة من تحرير التجارة. ونجد تأثيرا كبيرا على علاوة الأجور الشكلية حيث يؤدي تخفيض الحماية التجارية بمقدار نقطة مئوية واحدة إلى ارتفاع بنسبة 0.45 نقطة مئوية، في المتوسط، في فرق الأجور بين العمال الرسميين وغير الرسميين. ويظل التأثير قائما في ظل مواصفات مختلفة وعندما يتم تخفيف افتراض الطبيعة الخارجية لحماية الصناعة.

1. Introduction

Informality remains a common feature of labor markets in the developing world, often associated with low-paid jobs, sub-standard working conditions, and poor quality of work. The debate on whether informality is involuntary exclusion or a result of a rational cost-benefit evaluation continues (see, for example, Fields, 1990; Maloney, 2004; Ulyssea, 2020), yet our understanding about how informal employment, and thus wages, in industries exposed to foreign competition responds to trade liberalization remains limited, particularly for middle- and low-income countries. Indeed, if trade liberalization increases the demand for formal labor, it is likely to raise formal sector wages, potentially widening the wage gap between formal and informal workers. This paper, therefore, empirically explores how informal wages respond to trade shocks in developing countries, with a special focus on the case of Egypt.

Existing evidence suggests that labor markets may adjust to trade reforms along various margins: labor demand shocks leading workers to move outside tradable employment (Autor, et al., 2013), changes in the skill premium and labor reallocations across tradable sectors driven by product-factor price mechanisms as suggested by the Heckscher-Ohlin and Stolper-Samuelson models (Hanson and Harrison, 1999; Chiquiar, 2008)[3], shifts in relative industry wages and returns to industry-specific skills where constraints on labor mobility exist (Pavcnik et al., 2004; Goldberg and Pavcnik, 2005), and firms absorbing the shock by raising productivity and cutting profit margins in cases of excess profits, leaving employment and wages unaffected (Currie and Harrison, 1997).

Furthermore, in imperfectly competitive labor markets, where inter-industry mobility of labor is constrained, informality may open an additional adjustment margin, in which case the demand for informal jobs responds differently relative to formal jobs within the same industry. In this paper, we focus specifically on this latter mechanism. The dynamics of formal-informal wage differentials within an industry can have a profound impact on the demand for informal workers. Changes in the wage gap due to the labor market effects of trade liberalization can affect incentives and cost structures for both workers and employers, leading to shifts from informal to formal employment or vice versa.

Egypt makes an interesting case to examine closely for a couple of reasons. First, it is a relatively open, middle-income economy that has undergone significant economic reforms over the past decades, including reforms of labor and trade policies. Second, its large informal sector produces an undeclared economic output equivalent to more than a third of GDP and constitutes almost 50% of total employment (Schneider et al., 2011; Gatti, et al., 2014). This paper focuses on a major

[3] Some evidence from Mexico, especially in regions with greater exposure to international markets, supports labor reallocation; nevertheless, many developing countries experience frictions and rigidities that can hinder such smooth transitions (see, for example, Wacziarg and Wallack, 2004).

trade liberalization episode, during 1998-2006, due to the significant changes it brought to the structure of industry protection. This setup offers a quasi-natural experiment that facilitates a comparison of labor market conditions pre- and post- trade liberalization during the reform period. Notably, Egypt's pace of trade liberalization during this period ranked among the most aggressive in the developing world, trailing only fast-growing economies such as Chile and Philippines.

Against this background, this paper makes a two-fold contribution to this area of research. First, while several papers examined the effect on informal jobs, this study examines the wage differential effects of trade policy, with a special focus on Egypt, a rather understudied developing country. Second, we relax the exogeneity assumption of trade liberalization in relation to wages by using an instrumental variable (IV) estimation. To empirically test this relationship, we follow the two-stage empirical framework set in the seminal work by Goldberg and Pavcnik (2003, 2005), henceforth G&P, and Attanasio et al. (2004), using worker-level data from a national labor market survey and industry-level tariff data for industries exposed to trade in the tradeable sector.

Our results support the view that trade liberalization impacts the labor market through inducing employment shifts between formal and informal jobs *within* the same industry rather than labor mobility *across* industries. While the direction and magnitude of this effect have been indeterminate so far due to mixed empirical evidence, the findings of this paper lend support to the argument that liberalizing trade comes with a cost for the informal sector. Indeed, we find that 1-percentange point cut in trade protection for the average industry between 1998 and 2006 is associated with 0.45 percentage point increase in the formal wage relative to the average informal wage. These wage dynamics reflect the interplay of firm adjustment to increased competition[4] as well as labor market frictions, ultimately influencing the relative demand for informal employment. The results remain robust after addressing the potential endogeneity of trade protection and controlling for factors that may potentially confound the estimates of trade—informality studies, such as concurrent labor market reforms.

The rest of the paper is organized as follows. Section 2 reviews the related literature. Section 3 illustrates the developments in Egypt's trade policy, labor regulation and informal sector. Section 4 introduces the data. Section 5 explains the empirical strategy. The results are discussed in sections 6 and section 7 concludes and provides some policy implications.

[4] In response to trade-induce competitive pressures, firms may adjust efficiency wages – a concept integral to Saint Paul's (1996) dynamic efficiency wage model – above the market-clearing level to prevent workers from shirking and incentivize them to be more productive. Firms of heterogenous productivity levels can behave differently to the trade policy changes, according to Melitz-type trade models (2003); formal and informal jobs are created and destroyed simultaneously as more productive firms enter the trade sector, and least productive firms are forced to exit.

2. Literature review

This paper bridges two strands of literature, namely (a) determinants of informal wages; and (b) trade policy shocks, the informal sector and constrained labor reallocation in developing economies. The former examines how informal wages are shaped by both individual-level and macroeconomic factors. At the microeconomic level, characteristics such as education, gender, time flexibility, family burdern and skills have been shown to influence wage outcomes in the informal sector (Amuedo-Dorantes, 2004; Ahmed et al., 2014; Bargain and Kwenda, 2014; and Thaiprasert et al., 2020). At the macroeconomic level, broader structural factors – including taxes, trade openness, institutional quality – play a key role in determining informality in developing countries (Elgin and Erturk, 2019).

The second strand of literature focuses on how trade liberalization affects the informal sector, with consistent evidence showing that effects on employment and wage dynamics vary in direction and magnitude across different contexts (Tanaka and Greaney, 2024 and Ma, 2024). Several studies have observed an increase in informality, often accompanied by a decrease in informality premium. In Colombia, 1980s-90s trade reforms expanded within-industry informality, particularly before labor market reforms, with larger tariff reductions leading to wage declines, relative to the economy-wide average, in sectors employing less-skilled workers (G&P, 2003; Attanasio et al., 2004; G&P, 2005). Recent work for Brazil has found that trade liberalization accounts for 1-2.5% of the increase in informality from the 1980s to the early 2000s, and leads to an average informal wage decrease of 0.1 percentage points and a formal wage increase of 1.15 percentage points (Bosch et al., 2012; Paz, 2014). Similarly, in Argentina, approximately one-third of the informality increase during the same period was associated with trade liberalization, especially within industries facing intense competition (Acosta and Montes-Rojas, 2014). In Botswana, tariff reductions did not impact overall employment levels—possibly due to labor mobility constraints—but led to an increase in informal work within industries and tentative signs of reduced monthly incomes (McCaig and McMillan, 2020). In Peru, while tariff cuts initially reduced informal employment as low-productivity firms exited, the subsequent hiring of informal workers by formal firms to cut costs resulted in an overall increase in informality (Cisneros-Acevedo, 2022).

Other studies have documented a decrease in informal employment, though, on average, without a corresponding change in the informality premium. In Mexico, NAFTA's implementation correlated with a decrease in informal employment (and an increase in formal employment), predominantly driven by the formalization of large firms, yet without significantly affecting the formal-informal wage gap (Alemán-Castilla, 2006; Ben Yahmed and Bombarda, 2020). In Vietnam, workers moved from informal microenterprises to formal employment in response to

new exporting opportunities with the US, with the labor productivity gap between informal and formal enterprises narrowing when adjusting for worker differences (McCaig and Pavcnik, 2018).

Little is known about the effects of trade liberalization on the informal labor market in Egypt. Only a few studies have examined this relationship, and most look at relative demand for employment. Selwaness and Zaki (2015) use panel data on workers in Egyptian manufacturing industries for 1998-2006 and find that trade liberalization reduced the probability of informal employment. Salem and Zaki (2019), use more recent waves of the same panel worker dataset and present similar evidence that workers in the manufacturing industries are unlikely to pick informal jobs as trade is liberalized. Giovannetti et al. (2021) find that, overall, tariff changes have a negative effect on wages for Egyptian workers, with tariff increases doing more harm for workers than reductions do good; although their analysis does not specifically examine informal workers, it identifies no significant disparities between skilled and unskilled labor.

This work is also related to a burgeoning strand of literature that seeks to understand the extent to which changes in labor regulation and enforcement capabilities – both arguably influence the cost and incentives associated with hiring informal labor – affect how informality responds to trade protection (see, for example, Albrecht et al., 2009; Bosch and Esteban-Pretel, 2012; Almeida and Carneiro, 2012; Dix-Carneiro et al., 2021; Almeida et al., 2022; Ponczek and Ulyssea, 2022).

While much of the literature has focused on the informal *employment* effects of trade policies in Asian and Latin American countries, less attention has been paid to the *wage* effect, especially in the case of the Middle East and North Africa. This paper attempts to fill that gap by examining how trade liberalization affected the informality wage premium in Egypt.

3. Trade and labor background

3.1. Trade policy

Liberalizing the trade regime had been an integral part of successive waves of reform in Egypt's recent economic history as decades of protectionist import-substitution policies and state intervention have induced strong anti-export bias, leading to less integration in global trade (Kheir El-Din and El-Shawarby, 2000)[5]. The course of trade policy since the mid-1980s and concurrently with the start of the Uruguay Round of trade negotiations was to reverse this structural pattern, diversify exports and enhance exports performance in international markets. To this end, much of the reform efforts between the mid-1980s and the late 1990s were devoted to dismantling Non-Tariff Measures (NTMs) unilaterally. Quantitative restrictions that distort the market price

[5] During the 1980s and 1990s, Egypt's share in world exports fell from 0.2% in 1986 to 0.07% in 1996 (WTO, 1999). Trade balance was in deficit throughout this period, averaging 10% of GDP in 1997 (Refaat, 1999).

mechanism were abandoned along with the import licensing system, although the latter was replaced by an explicit 'import ban list' in 1986[6].

Tariff barriers also changed markedly during the 1990s owing to the Economic Reform and Structural Adjustment Program that Egypt implemented with the support of the International Monetary Fund (IMF) and the World Bank (WB). Between 1991 and 1997, dispersion and escalation in the tariff structure were sizably reduced and the applied Most Favored Nation (MFN) tariff range was halved gradually from 5–100% to 5–50% with a few exceptions (WTO, 1999). Taken together, the autonomous initiative to reduce tariffs and phase-out NTMs were instrumental for Egypt's active participation in the Uruguay Round and for its accession to WTO in 1995, both of which helped locking in these reforms and making the trade regime more transparent and rules-bound (Hoekman and Subramanian, 1999). Distortive NTMs were reduced considerably in scope and coverage and, at the very least, replaced by more transparent ones while the trade regime was gradually becoming more reliant on tariff duties as *the* main instrument for trade policy (WTO, 1999, 2005)[7].

The late 1990s and early 2000s – the period under study – witnessed further liberalization of Egypt's tariff regime. Between 1997 and 1998, the average applied MFN tariff fell by 12% to 27.6% (Figure 1). From 1999 to 2003, tariffs did not continue the downward trend possibly due to the unfavorable internal and external developments that hampered the economy at the time, including a domestic stock market collapse in 2001 and the global financial crisis of late 1990s (Dobrongov and Iqbal, 2007). Average protection increased marginally by 3% from 1998 to 1999 and remained unchanged until 2001. Liberalization gained momentum again from 2002 onwards with substantial tariff cuts in 2004 spearheaded by the then newly appointed, market-oriented cabinet that aggressively advanced trade reforms[8] and privatization of state-owned enterprises, among other economy-wide reforms (Lawrence and Galal, 2005). Tariffs were reduced by 31%, from 28.6% in 2001 down to 19.6% in 2006[9].

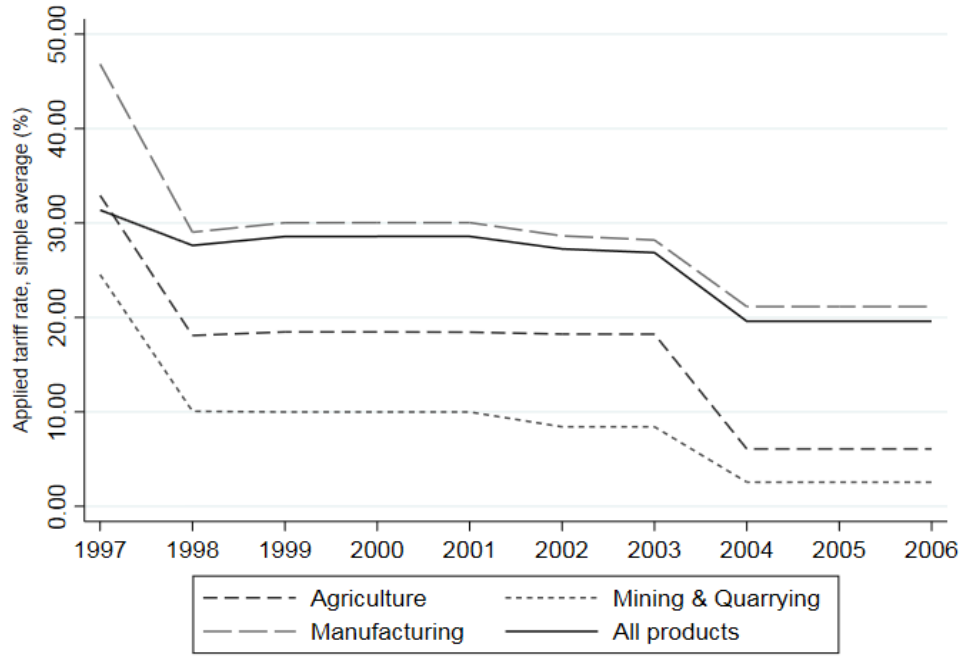
[6] Other NTMs removed include prior import deposits, marine duty and municipal tax, and letters of credit. The list contracted over the 1990s to cover only some poultry and textile items that account for less than 4% of domestic production, most of which were eventually removed by 2005 as per the Uruguay Round commitments. Nevertheless, items that were taken off the list were either tariffed at high rates or added to a mandatory 'quality control list' that indeed expanded in coverage from 32 items in 1994 to 191 items in 2002 (Refaat, 2003). While quality control effectively adds restriction in the form of delayed clearance and inspection fees, it is arguably more acceptable than import prohibition on the grounds of health, standard, and quality reasons.

[7] The use of WTO-legitimate NTMs was also rather limited. Between 1998 and 2005, only 14 definitive anti-dumping cases and two safeguard measures were imposed by Egypt. This drastic change in the pre-sample trade policy gives more confidence and credibility in using tariff duties as a proxy for trade policy throughout the paper's sample period.

[8] A major pillar of this agenda was negotiating key and strategic trade agreements with the EU, US, and African countries. The pursuit of such preferential trade agreements offers a strong incentive to attempt tariff cuts whether preferentially for member countries to increase trade flows or even externally to non-member countries to avoid trade diversion concerns by the WTO.

[9] Between 2004 and 2006, Egypt signed several regional trade agreements with a number of key trading partners, including the EU–Egypt Free Trade Area (FTA) and the Agadir FTA with Jordan, Morocco, and Tunisia (WTO, 2005).

Figure 1. Simple average applied MFN tariffs in Egypt, 1997—2006



Source: Authors' calculations based on WTO data.

Table A1 in Appendix presents detailed descriptive statistics. All industries underwent a reduction in their level of protection during this period. Forestry saw the largest reduction with the tariff rate going down by 83%, whereas the least cuts were in food and beverages and wearing apparel. Manufacture of food and beverages remained most protected in both 1998 and 2006, with a tariff rate at 106.5% and 102.5%, respectively. This is a result of alcoholic beverages and spirits being subject to prohibitive duties of up to 3000%, mainly due to religious reasons rather than protection per se (Kheir El-Din and El-Shawarby, 2000).

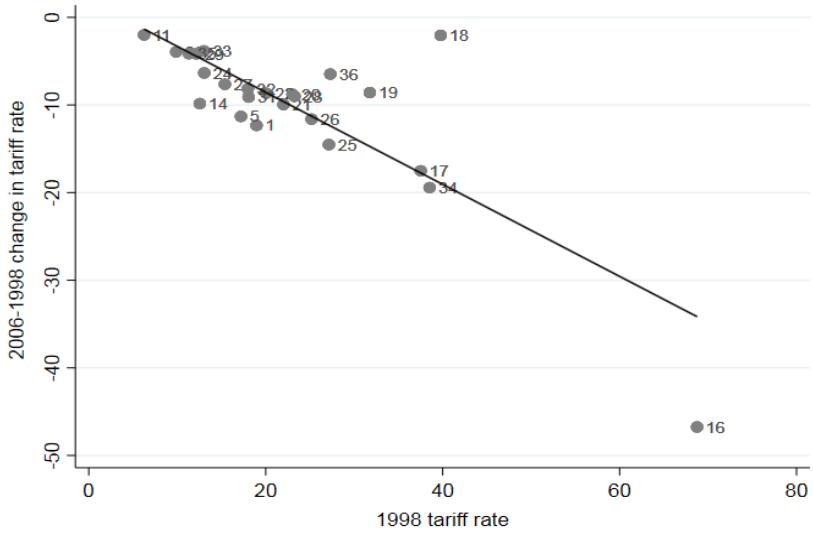
Excessively high tariff duties on items such as clothing and alcoholic beverages are responsible for Egypt's highly dispersed tariff structure[10]. They are largely also responsible for the pattern of positive escalation, i.e. tariff duties on semi-processed products are higher relative to raw materials and are higher still on processed products[11], which can be problematic for this paper's inferences as it makes the Effective Rate of Protection (ERP) higher than the nominal rate of protection[12]. Nevertheless, two caveats should be borne in mind, which would increase confidence in using the nominal rates given the absence of ERP for the paper's sample period. First, the pace of trade liberalization post 1991 was quicker and more focused on tariff-based protection as *the* trade policy

[10] Standard deviation declines from 140 percentage points to 14.7 when alcoholic beverages and spirits are removed.
[11] Escalation is highest in food & beverages and wearing apparel industries (WTO, 2005).
[12] Kheir El-Din and El-Dersh (1992) estimated a correlation coefficient of only 0.51 between the nominal rate and ERP during 1986-1991, a rather moderately strong association.

instrument. Second, excluding exceptionally high tariff duties reduces the positive escalation tremendously; hence, the discrepancy between the nominal rate and ERP narrows (Galal and Lawrence, 2004).

The latter point implies that tariff reductions – excluding the outliers – introduced a greater degree of uniformity in terms of protection across industries. This is a product of the across-the-board approach to tariff reductions that Egypt followed between 1998 and 2006—unlike earlier tariff revisions that involved some degree of discretion (Hoekman and Djankov, 1997; WTO, 2005). In fact, this approach is crucial to the exogeneity assumption of tariff changes which we rely upon in this paper to draw causal inference even if this assumption is relaxed at a later stage. If changes to the tariff structure were imposed differentially, say, based on industry characteristics or political economy factors like lobbying, then the exogeneity assumption would be violated.

Figure 2. Plausible exogeneity of tariffs, 1998—2006



Source: Author's calculation based on WTO data.

Notes: Correlation: -0.82; regression coefficient: -0.548; standard error: 0.056; t-statistic: -9.78. Numbers indicate industry two-digit code. Manufacture of food and beverages is excluded.

Figure 2 lends support to the *plausible* economic exogeneity of tariffs changes. The graph suggests that industries with high initial tariffs in 1998 experienced the largest tariff reductions[13]. So, what explains why certain industries have liberalized faster than others are differences in the starting point: an industry with a high tariff *level* sees a relatively large, downward *change* in its tariff. We find this observation consistent with the trade literature's narrative that tariff cuts were determined overarchingly for the whole economy, rather than at the level of industries, driven by a national

[13] The correlation increases from -0.82 to -0.93 if wearing apparel industry (18) is also excluded as commonly done in Egypt's trade literature.

objective of putting the country on a competitive outward-oriented path (see, for example, Hoekman and Subramanian, 1999; Morley and Perdikis, 2000; Alissa, 2007). This arguably leaves little room for differential protection and thus the endogeneity of tariffs. Altogether this offers a great setting for studying the labor market adjustment to trade policy reforms.

To put the trade policy developments over the period of study in a comparative context, Table 1 shows simple average MFN tariffs for selected countries between 1998 and 2006. Two interesting insights emerge: Egypt's tariff-based protection is quite comparable to its neighboring MENA countries, and despite outperforming both Tunisia and Morocco in 2006, protection remains higher than is prevailing in developing countries. Nevertheless, Egypt's pace of trade liberalization was among the strongest in the developing world, coming right after fast-growing economies like Chile and Philippines.

Table 1. Simple average tariffs in selected countries, 1998–2006

Country	Tariff rate (%)		
	1998	2006	% change
Egypt	**27.6**	**19.6**	**-29**
Argentina	13.5	12.2	-10
Brazil	14.6	12.3	-16
Chile	11.0	6.0	-45
Colombia	11.7	12.5	7
Mexico	13.3	14.0	5
Malaysia	8.7	8.5	-2
Philippines	11.2	6.3	-44
Morocco	25.0	24.5	-2
Tunisia	33.6	26.8	-20

Source: Olarreaga and Madani (2002); WTO and ITC (2007).

3.2. Labor regulation and informality in the labor market

Overly rigid labor regulation has had its toll on the functioning of Egypt's labor market for decades. The stringent features of the 1981 Labor Law in force throughout the 1980s and 1990s required employers to obtain judicial approval for worker dismissal and prohibited the termination of indefinite duration contracts for economic reasons (Wahba and Assaad, 2017). With burdensome labor regulation and high labor taxes in terms of social security contributions, one major private sector response has been to bypass the regulation-induced rigidities – seizing the opportunity of weak labor law enforcement – by underreporting part of its workforce and/or hiring workers from the *de facto* flexible informal sector[14]. Unsurprisingly, this places Egypt among the countries with most rigid labor regulation in MENA—a region which is among the most restrictive in the developing world (Pissarides and Véganzonès-Varoudakis, 2006).

[14] Some 20% of total informal workers were hired by formal enterprises in 2003 (Elbadawi and Loayza, 2008).

In response to these inefficiencies, the 2004 reforms of labor regulation were introduced as a key pillar of a business deregulation package that stimulates the private sector activity. The passage of the 2004 Labor Law granted employers flexibility in the hiring and firing processes to improve their adjustment to economic conditions[15]. For example, employers were given the right to lay off workers for economic reasons, terminate indefinite duration contracts with less cumbersome dismissal rules, and hire on fixed-term contracts (Yassin and Langot, 2018). Nevertheless, while hiring regulations in Egypt became quite flexible by international standards, firing regulations remain highly restrictive, despite the move toward greater labor market flexibility, arguably due to the limited unemployment and social insurance coverage by the government (Angel-Urdinola and Kuddo, 2010)[16].

These regulatory changes, along with broader economic reforms, coincided with a significant change in the structure of employment in the labor market between 1998 and 2006. The key highlight was the diminishing role of the public sector due to the privatization drive of the early 2000s and the slowdown in hiring via the long-standing policy of employment guarantee. The share of public sector employment in total employment declined by 24%, from 46% in 1998 to 35% in 2006, leaving the private sector absorbing the young entrants to the labor force and the inflow of civil servants (Table 2). A closer look at the data shows that the informal private sector outpaced its formal counterpart in this absorption process. The share of the former increased considerably by 32% to account for almost 50% of total employment in 2006 while the latter stagnated at 16%. Interestingly, however, the growth of formal private employment as a share of wage employment was faster than that of informal private employment, although the informal type was still dominant. Formal private wage employment grew by 45% while informal private wage employment grew by 14%[17].

The characteristics of formal and informal workers are examined in Table A2 in Appendix. Considerable individual, household, and job differences are observed between the two types of workers, implying that selection into informality is non-random. In both 1998 and 2006, the average informal worker is younger, less experienced, less educated, works more hours per day – though the variance is huge signaling more flexibility in work arrangements, works in a microenterprise of fewer than five employees, and receives no employee benefits such as annual leave, sick leave, and medical insurance. In contrast, formal workers enjoy better working conditions, higher job stability in terms of permanent positions, work in larger firms, and are more likely to be members of a trade union. Female participation in the labor market is generally very low, albeit slightly higher in the formal sector given that many educated women prefer public sector jobs (Assaad, 2009).

[15] The law referred to is law number 12 of 2003, which came into force in 2004.

[16] A third-party government agency must approve and be notified of the termination of a redundant worker and severance pay can reach up to 27.5 months of salary for 20 years of tenure.

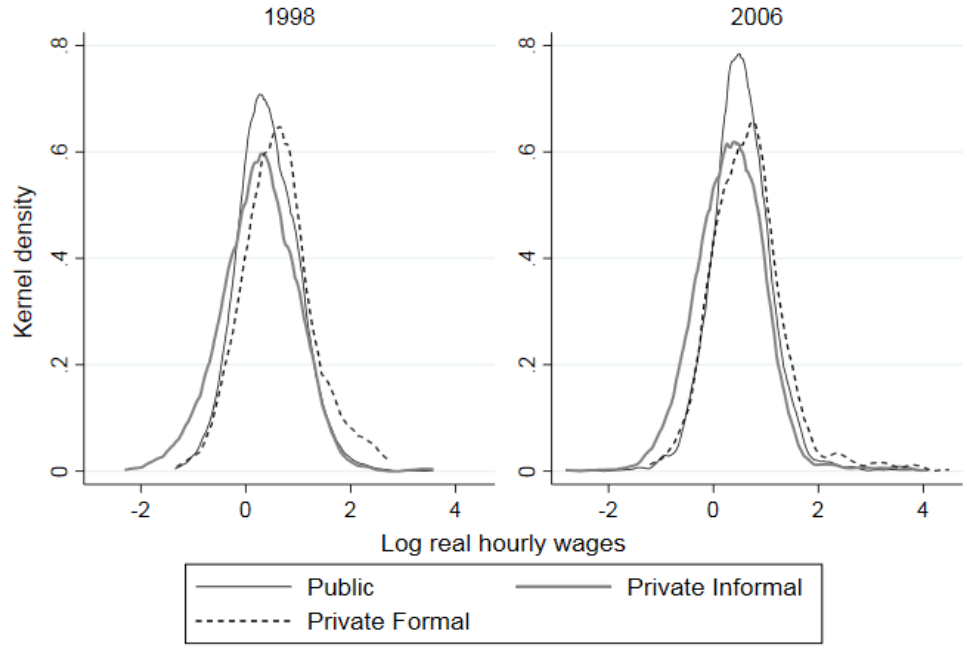
[17] Wahba and Assaad (2017) attributed this formalization trend causally to the passage of the 2004 Labor Law, though the public sector remains the main employer of wage employees.

Table 2. Structure of employment in Egypt, 1998—2006

Type of employment	Total employment		Public sector		Private sector			
					Formal		Informal	
	1998	2006	1998	2006	1998	2006	1998	2006
Wage employee (%)	68	58	100	100	47	58	38	29
Employer (%)	12	16	—	—	31	26	19	25
Self-employed (%)	11	12	—	—	19.5	14	20	19
Unwaged work (%)	9	14	—	—	2.5	2	23	27
% of total employment	100	100	46	35	16	16	37	49
% of wage employment	100	100	68	60	11	16	21	24

Source: ELMPS 1998 and 2006.

Figure 3. Wage distribution for wage workers, 1998—2006



Source: ELMPS 1998 and 2006.

Note. Wages in 1998 are adjusted for inflation and reported in 2006 EGP (inflation factor is 1.43). Wages include basic wages only, excluding incentives, bonus, overtime, etc.

Figure 3 offers a perspective on the differences in wage earnings. Median real wages in the informal private sector are lower than in the formal private and public sectors. While the formal private sector offers the highest pay, two important factors reinforce the 'queues' for public sector jobs[18] – a salient feature of the Egyptian labor market. First, the fringe benefits offered by the public sector can reach up to 100% of the basic wage (McCormick and Wahba, 2004). Second, the

[18] The work of Yassin and Langot (2018) suggests that the increased competitiveness of the public sector jobs alongside the slowdown in hiring tend to offset the positive effects of the 2004 Labor Law on job creation in the formal private sector and contribute to a larger informal sector: workers, especially the young, seek informal employment temporarily while waiting for a public sector job. Many studies support this view (see, for example, Wahba, 2009).

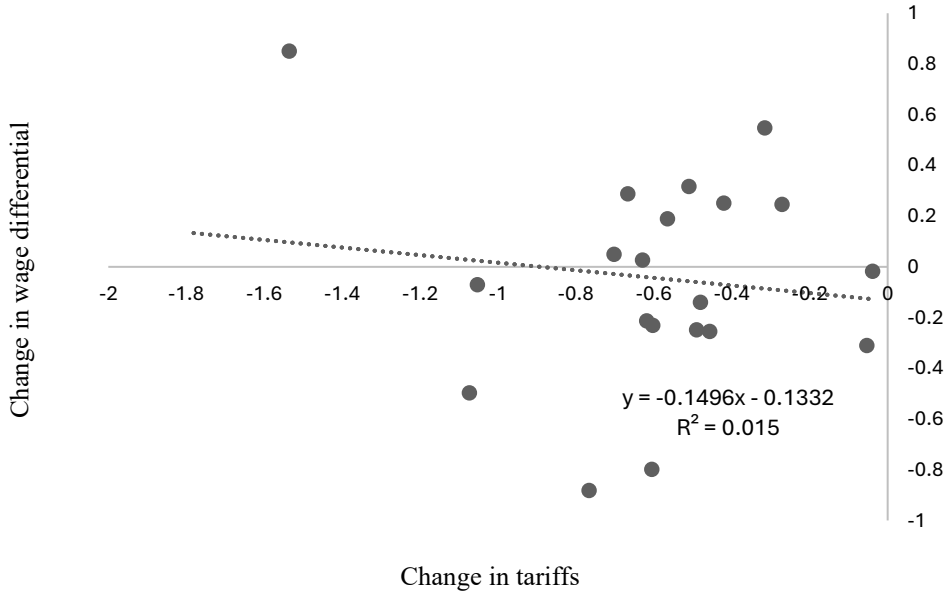
median real basic wage in the public sector increased substantially, making public sector jobs even more attractive, especially for the young.

Tables A3 and A4 in Appendix provides summary statistics on the share of wage employment, the share of informality, and formal and informal hourly wages across industries. The service industry clearly dominates wage employment with a share above 70% between 1998 and 2006, largely driven by employment in public and community services and in predominantly informal industries such as retail and wholesale trade and construction. The share of service in wage employment grew by 3%, whereas it fell for agriculture, mining and quarrying, and manufacturing by 3%, 3%, and 13%, respectively. As expected, informality in wage employment is widespread in agriculture, accounting for 84% and 82% of total jobs in 1998 and 2006, respectively. Manufacturing follows with a share of informality that increased from 37% in 1998 to 40% in 2006. Lastly, the share of informality in service stood at 32% in 2006, up from 26% in 1998 – the highest growth during the period. Looking at informal versus formal wages, manufacturing had the largest *unadjusted*[19] wage gap in 1998; the hourly wage was EGP 1.75 for the median formal worker and EGP 1.38 for the median informal worker, giving a formal-informal wage ratio of 1.27. By 2006, this wage gap was largest in the service industry (1.28).

Finally, Figure 4 shows a negative association between the percentage change in tariffs and the change in the wage differential between formal and informal workers. This pattern suggests that when trade liberalization occurs, the wage differential increases. Industries facing deeper tariff reductions tend to experience larger increases in the formal–informal wage gap. This finding offers preliminary evidence that formal workers are more likely to benefit from trade openness, while informal workers may face increased competition and potentially lose out.

[19] Unadjusted wage gap does not consider observable worker differences.

Figure 4. Correlation between the percentage change in tariffs and the percentage change in the wage differential, 1998—2006



Source: Authors' own calculation based on WTO and ELMPS data.

Note: The wage differential measures the difference between the wage of formal and informal workers.

4. Data

Information on Egypt's tariff schedule for the period 1998-2006 is obtained from the WTO Integrated Data Base (IDB), which originally comes from the Egyptian Customs Authority. We use *ad valorem* MFN current applied duties. These nominal tariff duties are reported according to the Harmonized System (HS) for product classification at its most detailed level of disaggregation, the six-digit level. Following recent work in the trade literature, we use simple average tariffs for all products and refrain from constructing import-weighted tariffs. This is to avoid the criticism that import-weighted tariffs tend to understate protection, as the value of imports become smaller, when tariff rates are prohibitively high (Lee, 1993; Estevadeordal and Taylor, 2013).

For carrying out the analysis at an industry level, we convert the HS product tariff duties to the four-digit International Standard Industrial Classification (ISIC – Review 3) of economic activities using the concordance between both nomenclatures available by the WB World Integrated Trade Solution (WITS) software. Finally, we aggregate tariff duties at the two-digit industry level –

called ‘industry divisions’ according to the ISIC. This level of aggregation is believed to be the most suitable for matching labor market data, distinguishing 34 industries per year[20].

Labor data are drawn from the Egypt Labor Market Panel Survey (ELMPS) carried out by the Economic Research Forum in cooperation with Central Agency for Public Mobilization and Statistics (CAPMAS) – the official statistical agency of Egypt. The ELMPS is nationally representative and is designed as a panel survey that tracks labor market and demographic characteristics of households and individuals over time (Barsoum, 2007). We use the first and second survey waves: ELMPS 98 and ELMPS 06 that are adequate for the quasi-natural experiment we are interested in. The ELMPS 98 sampled 4,816 households (23,997 individuals), whereas 8,349 households (37,140 individuals) were interviewed in the ELMPS 06. Of the total individuals interviewed in 2006, seventy-two percent were successfully traced from the 1998 wave and around 62% of the new individuals were part of a refresher sample. Attrition in the 2006 wave was mostly due to the random loss of identifying information records and inability to locate split households rather than a systematic attrition process (Assaad, 2009).

The analysis in this paper is carried out within the frame of two repeated cross-sections, leveraging the availability of a large refresher sample. What is crucial for this analysis is the functioning and representativeness of the labor market rather than tracking individuals’ outcomes over time[21]. The sample is restricted to wage earners engaged in the labor market due to measurement issues in unwaged agricultural work (see Assaad, 2009 for a detailed discussion)[22]. This results in a sample of 4,885 and 7,612 observations for 1998 and 2006, respectively. The ELMPS data provides information on employment, demographic, and household characteristics (See Table A5 in Appendix for more details on the variables used in the analysis). Importantly, the employment industry is reported at the two-digit ISIC level, which is the key for merging the industry dataset with the labor market dataset[23].

Following the literature on informality in Egypt, we define informal employment as employment that is not covered by either a legal contract or social security, both of which are covered through specific questions by the ELMPS. This is the working definition of the International Labor Organization (ILO) job-based definition of informal employment endorsed in 2003 by the 17th International Conference of Labor Statisticians (ILO, 2003). The strength of this definition is that it does not preclude the possibility of informal workers being employed by formal employers[24];

[20] The trade-off is that at a higher level of disaggregation, say, the three- and four-digit ISIC levels, many industries have fewer than 10 workers.

[21] Sample weights are used to make the survey more representative of the ‘true’ population. Weights are calculated according to the actual population size of each sampling stratum in the Population Census and consider non-response and random attrition (Assaad and Roushdy, 2009).

[22] Furthermore, self-employed individuals, employers, and unwaged workers are excluded as they do not report earnings.

[23] A total of 32 industries with tariff information are merged with the data on individual workers.

[24] Commonly referred to as the ‘intensive margin’ of informality (see Ulyssea, 2020 for a detailed discussion).

formal employers are likely to circumvent the inflexibility of labor regulation by hiring on an informal basis. More precisely, an employee may hold an informal job, conditional on not having either a legal contract or entitlement to social security or both, regardless of the formality status of the employer.

5. Econometric strategy

5.1. Baseline specification

Following the labor literature, particularly the empirical framework by G&P (2003) and its extensions by Attanasio et al. (2004) and Alemán-Castilla (2006), we use a *two-step* estimation procedure to investigate the relationship between trade policy and formal-informal wage differentials. In the first stage, we estimate a Mincer-type regression that controls for worker characteristics and industry affiliation. Some modifications are, however, made using interaction terms to allow for the wage to vary across formal and informal workers. The regression takes the form

$$\ln(w_{ijt}) = \boldsymbol{H_{ijt}\beta_t} + \boldsymbol{I_{ijt}} \times \boldsymbol{ip_{jt}} + (\boldsymbol{H_{ijt}} \times formal_{ijt})\boldsymbol{\rho_{it}} + (\boldsymbol{I_{ijt}} \times formal_{ijt})\boldsymbol{\gamma_{jt}} + \varepsilon_{ijt} \quad (1)$$

where $\ln(w_{ijt})$ is the natural logarithm of the real hourly wage for worker *i* in industry *j* at time *t*, $formal_{ijt}$ is a dummy variable indicating worker formality status, $\boldsymbol{H_{ijt}}$ is a vector of worker characteristics including age, education, geographic location, gender, marital status, household size, unemployed members in household, union membership, $\boldsymbol{I_{ijt}}$ indicates worker *i* industry affiliation, $(\boldsymbol{H_{ijt}} \times formal_{ijt})$ is a matrix of interactions between worker *i* characteristics and the indicator of formality, $(\boldsymbol{I_{ijt}} \times formal_{ijt})$ is a matrix of interactions between worker *i* industry affiliation and formality, and ε_{ijt} is the error term. The coefficients, $\boldsymbol{\rho_{it}}$, capture the part of the variation in the wage gap that is explained by the differences in worker characteristics between formal and informal workers. The coefficients of interest, $\boldsymbol{\gamma_{jt}}$, capture the part of the wage gap that is attributable to industry affiliation and that cannot be explained by differences in observable worker characteristics. Let us denote these coefficients as *industry formal-informal wage differentials (formality premiums)*, which we normalize to interpret as deviations from an employment-weighted average. These coefficients can be expressed as the percentage point difference in the industry wage premium of a formal worker *i* in industry *j* relative to the average, observationally similar, informal worker in all industries. This normalization process and the correction of the standard errors that it entails are done using the Haisken DeNew and Schmidt (1997) two-step restricted least squares procedure[25]. Note that the normalized coefficients are not

[25] The procedure expresses industry differences as deviation from a hypothetical employment-share weighted mean à la Krueger and Summers (1988) but adjusts the variance-covariance matrix of the renormalized coefficients to avoid sensitivity to the omitted base category and overstating standard errors that would otherwise lead to spurious inferences.

interpreted with respect to an arbitrary reference industry that would otherwise make the interpretation less meaningful, at least in an economic sense.

In the second stage, the estimated differentials coefficients $\boldsymbol{\gamma_{jt}}$ are pooled over time and regressed on tariffs and industry characteristics. The second-stage regression takes the following form

$$\gamma_{jt} = \delta_1 T_{jt} + \boldsymbol{Z_{jt}\pi_t} + \mu_{jt} \quad (2)$$

where T_{jt} is the tariff for industry *j* at time *t*, $\boldsymbol{Z_{jt}}$ is a vector of various industry characteristics and a time indicator, and μ_{jt} is an error term such that $E(\mu_j|T_j, \boldsymbol{Z_j}) = 0$ for all *j*. We estimate Equation (2) using a pooled cross-sectional model and/or Fixed Effects (FE) model if an *F*-test of joint significance is indicative of controlling for industry fixed effects. Equation (3) is also estimated with Weighted Least Squares (WLS) since the dependent variable is itself an estimate; thus, more weight is given to industries with smaller variance. The inverse of the variance of the informality differentials obtained from the first stage are used as weights. Further, heteroscedasticity and serial correlation in the error term are accounted for by using robust Huber-White standard errors clustered by industry.

5.2. Controlling for the endogeneity of trade liberalization

The exogeneity of tariffs in Equation (2) holds if unobserved factors affecting formality wage premiums are not systematically correlated with tariffs. However, and despite the *plausible* exogeneity of tariffs that this paper relies upon as previously explained, there might be unobserved factors that affect (in)formal wages and tariff formation simultaneously, as political economy theories of trade protection would suggest (see, for example, Baldwin, 1989). Should this be the case, then the exogeneity assumption is violated, implying that $cov(T_{jt}, \mu_{jt}) \neq 0$ in econometric terms, and eventually rendering the estimates biased. For instance, if protection responds to the bargaining power of unions, and unions have a direct effect on formal wages, the coefficient on tariffs would be biased. Also, if policymakers systematically grant more (less) protection to industries with, say, high proportion of unskilled (skilled) workers, and by turn wage formation is affected, one would expect this to bias the estimates[26]. In this vein, a good example is the skill-biased technological change which, to the extent that informal workers are also low-skilled, may be a confounding variable. Not only is there a potential omitted variables bias, but also a simultaneity bias: a study by Olarreaga and Madani (2002) found that wages are a significant determinant of Egyptian manufacturing tariff levels in 1999.

To deal with potential endogeneity, we control for additional industry-level variables in Equation (2). These include the share of skilled workers to capture industry human capital and skill-biased

[26] Initial tariffs in 1998 and the share of skilled workers are inversely related at the 5% significance level.

technological change and the share of union members to proxy for industry organization and union bargaining power, both of which are constructed using ELMPS data.

A second strategy for addressing potential endogeneity in Equation (2) and dealing with the various sources of bias, we opt for instrumenting tariff changes with oil prices interacted with pre-reforms tariff levels. This is in line with G&P (2005) whereby they turn to the history of industry protection in Columbia and rely on the institutional details of reform to come up with good instruments.

Much like the Columbian case, the Egyptian economy throughout its recent history has been overly reliant on a few sources of earnings, most of which are indexed to world oil prices, however. The economy grew at a remarkable average of 8% during 1974-85 thanks to windfall gains from high oil prices and oil exports, Suez Canal revenues, and remittances from oil-producing Gulf States (Alissa, 2007). Yet, by the same token, the collapse of oil prices threw the economy into a tailspin in the years that followed, which determined the onset of economic reforms by the early 1990s. This historical dependence provides a compelling case for the conceptual validity of using oil as an instrument, i.e. a trigger of trade reforms in Egypt[27].

Nonetheless, oil prices as an instrument – essentially an exogenous macroeconomic factor in determining the onset and pace of economy-wide reforms in Egypt – cannot explain why some industries liberalized faster than others. Put simply, unless allowed to vary by industry-specific factors, the shock should apply equally to all industries in this framework, thus becoming economy-wide rather than industry-specific shock. Therefore, the question that arises is what are the factor(s) that explain why some industries liberalized faster than others, i.e. what accounts for the cross-sectional variation? Here, the fact that Egypt's pursuit of trade reforms in the early 2000s was mostly through preferential trade agreements with strategic trading partners can be quite useful. Negotiations with trading partners and WTO regulations required Egypt to achieve an economy-wide uniform tariff rate that, in principle, does not discriminate between industries, i.e. preordained by factors that industry lobbying cannot influence. This leads us back to Figure 2 and its key observation: the significant association, at the 1% level, between initial tariff levels in 1998 and the change in tariffs over 1998-2006 indicate that industries with higher initial tariff levels, i.e. at baseline, were the ones that experienced the largest tariff reductions to arrive at a flat, final tariff level set for the economy.

Thus, to yield industry-specific, time-varying instruments, we interact 1998 tariff levels with current oil prices. For this IV to be valid, it must convincingly meet the untestable 'exclusion

[27] While we should be careful with causality, much of the literature on Egypt's trade seems to posit that the collapse of oil prices in the mid-1980s and the consequential current account deficit made the government adamant to begin reforms in various sectors of the economy including the trade sector (Kheir El-Din and El-Dersh, 1992). In fact, regressing total applied MFN tariffs between 1998 and 2006 on world oil prices for the same period reveals a strong positive correlation. Correlation: -0.86; regression coefficient: -0.239; standard error: 0.053; *t*-statistic: -4.539.

restriction'. By focusing on the interaction between initial tariff levels in 1998 and oil prices, the exogenous variation in tariffs that is not directly related to wage differentials can be isolated. This arguably limits any direct correlation with contemporaneous wage differentials, ensuring that the instrument's effect is mediated solely through its effect on tariffs. Hence, the underlying identification assumption of this IV approach: tariffs affect the formal-informal wage differential only through the effect that initial 1998 tariff levels (and the interaction with oil prices) have on tariff reductions during 1998-2006.

6. Trade policy and formal-informal wage differential

6.1. Baseline results

As outlined earlier, the empirical strategy proceeds in two stages. The first involves estimating the industry premium, while the second examines the effect of tariff changes on the informality premium. First stage results on the logarithm of hourly wages for 1998 and 2006 are reported in Table 3. The formal-informal wage differentials are jointly statistically significant. Formality premium, relative to the average informal worker in the economy, ranges from -11% (other service activities) to 98% (manufacture of office and computing machinery) in 1998 and from -26% (manufacture of other transport equipment) to 74% (petroleum and natural gas) in 2006. Intertemporal correlation over 1998-2006 is weak (r=0.36) which suggests a potential role for the trade policy in influencing the differential between formal and informal wages.

First-stage controls are reported in Table A6 in Appendix. The regressions explain 29% and 21% of the variation in the logarithm of hourly wages in 1998 and 2006, respectively. As human capital theory suggests, experience has a positive but non-linear effect on wage earnings. An additional year of experience is associated with a 3.6% and 4.5% increase in wages in 1998 and 2006, respectively, however, with a diminishing rate of return over time. Nonetheless, years of experience are not a determinant of the wage differential between formal and informal workers at conventional significance levels. Gender seems to be a significant determinant of wage earnings as well as differences in earnings of formal and informal workers at the 1% level.

Being a household head is inversely related to wage earnings only in 2006 but is not associated significantly with the differences in wage earnings between formal and informal workers. Being married, on the other hand, is associated positively and significantly with higher earnings in both years but is significantly smaller for formal workers in 1998 only. Membership in a trade union is associated with higher earnings in 2006 only at the 10% level and generally, *ceteris paribus,* does not contribute to the gap between formal and informal wages. This might be rather surprising at first glance as one would expect the bargaining power of trade unions to raise formals wages above market-clearing levels; however, much of Egypt's literature posits that unions affect wages

minimally as unions are largely restricted and controlled by the government (El Mahdi, 2002; Tansel et al., 2020).

Table 3. First-stage results: Normalized industry formal-informal wage differentials, 1998—2006

Industry		1998	2006
01	Agriculture, hunting and related service	-0.056	-0.027
02	Forestry, logging and related service	-0.020	—
05	Fishing, fish hatcheries and farms	0.539***	0.187***
10	Mining of coal and lignite	0.131	—
11	Extraction of crude petroleum and natural gas	0.379***	0.738***
14	Other mining and quarrying	0.026	0.193***
15	Manufacture of food and beverages	0.077*	0.031***
16	Manufacture of tobacco	0.101***	-0.170***
17	Manufacture of textiles	-0.032	-0.172***
18	Manufacture of wearing apparel	0.304***	0.014
19	Manufacture of leather	0.317***	-0.090***
20	Manufacture of wood and wood products	0.326***	0.678***
21	Manufacture of paper and paper products	0.213***	-0.091***
22	Publishing and printing	0.451***	0.038
23	Manufacture of coke and refined petroleum	0.435***	0.404***
24	Manufacture of chemicals	0.386***	-0.050***
25	Manufacture of rubber and plastic	0.133***	-0.209***
26	Manufacture of other non-metallic products	0.230***	0.151***
27	Manufacture of basic metals	0.176***	0.157***
28	Manufacture of fabricated metals	0.081*	0.041***
29	Manufacture of machinery and equipment	0.087*	-0.026
30	Manufacture of office, accounting, and computing machinery	0.976***	—
31	Manufacture of electrical machinery	0.263***	0.063
32	Manufacture of radio, TV, and communication equipment	0.267***	-0.190***
33	Manufacture of medical equipment	0.333***	-0.107***
34	Manufacture of motor vehicles	0.192***	0.057***
35	Manufacture of other transport equipment	0.096*	-0.255***
36	Manufacture of furniture; Manufacturing N.E.C	0.026	0.400***
40	Electricity, gas, steam and hot water supply	0.013	0.035
74	Other business activities	0.153***	-0.036
92	Recreational, cultural and sporting activities	0.156***	-0.130***
93	Other service activities	-0.112***	-0.145***
Controls		Yes	Yes
Standard deviation		0.139	0.224

*Note. Standard deviation is a measure of overall dispersion computed by the Haisken-DeNew and Schmidt (1997) procedure. *** p<0.01, ** p<0.05, * p<0.1.*

The coefficients on education reflect the developments in the labor market throughout this period. In 1998, the return to education was clearly progressive. On average, and controlling for observable characteristics, a worker with a university education or above earned a 57% higher wage than an illiterate worker. By 2006, the coefficients on the primary and preparatory stages turned insignificant relative to an illiterate worker whereas intermediate and above intermediate education became only important in determining the formal-informal wage differential, at the 5% level or better. One possible explanation is that bad low-pay jobs created in the economy were absorbed by workers with lower education, and although a large proportion of highly educated

workers were also employed informally by 2006 in tandem with the decline in public sector employment, more years of education were still rewarded highly by formal relative to informal jobs (Angel-Urdinola and Semlali, 2010).

Table 4 reports the WLS estimates on the effect of tariffs on the wage differential – the second stage results. The pooled cross-section specification (column 1) suggests that tariffs and formality premium are inversely related at the 10% level. Surprisingly, an F-test on the joint significance of industry dummies came insignificant at conventional significance levels (F-stat=1.49) indicating that the data is poolable, i.e. unobservable time-invariant industry characteristics do not bias the results[28]. In column 2, we add share of union members and share of skilled workers as regressors. As a result, the coefficient on tariffs increases in magnitude and significance. The results in column 2 thus imply that eliminating the protection received by an industry with the economy-wide average of 28% in 1998 and 20% in 2006 would be associated with 13% (0.45 × 0.28 × 100) and 9% (0.45 × 0.20 × 100) increase in the formality wage premium in this industry relative to the average informal worker, respectively. Put differently, industries with high initial tariff levels, which were also those that experienced the largest tariff cuts, exhibit more divergence between formal and informal wages than industries with slower pace of liberalization.

Table 4. Second-stage results (WLS estimation): The effect of trade policy on the industry formal-informal wage differentials

	(1)	(2)
Tariff	-0.375*	-0.457**
	(0.189)	(0.221)
Share of union members		-0.508*
		(0.293)
Share of skilled workers		0.023
		(0.245)
Constant	0.287***	0.435**
	(0.058)	(0.165)
Year indicators	Yes	Yes
Obs.	61	61
R-squared	0.12	0.22

*Note. Robust standard errors clustered at 2-digit industry level are in parenthesis. The dependent variable is formal-informal wage differential. *** p<0.01, ** p<0.05, * p<0.1*

6.2. IV estimation

Table 5 reports the estimates of the IV regressions. Columns 1—2 use the interaction between 1998 tariff levels and oil prices as an instrument to estimate the effect on formality premium in *levels* form, while columns 3—4 estimate the effect on the *change* in premium. The reduced form

[28] Because this may be surprising given that one would *a priori* expect industry indicators to be important controls, we experiment with controlling for the unobserved heterogeneity (not reported). We ran a Hausman test on whether to use a FE or a Random Effects (RE) model, which came in favor of the latter (*p*-val=0.1788). This means that RE model is more efficient and that unobserved effects are uncorrelated with the regressor, i.e. the trade policy variable. The coefficient on tariffs in the baseline RE specification is significantly negative at the 10% level: coefficient: -0.236; standard error: 0.093; *t*-statistic: -2.52.

regressions in Panel A provide support for the instrument being an important determinant of tariff rates. A battery of tests is also presented to assess the appropriateness of the instrument econometrically.

Our instrument performs relatively well on relevance and weak identification tests. The explanatory powers of the IV regressions are comparable to those of the baseline WLS specification – around 22% of the variation in the dependent variable is explained by the regressors. Overall, the results in Panel B point toward a significant negative relationship between the formal-informal wage differential and trade protection within industries. However, the magnitude of the tariff coefficient is larger compared to the baseline specification in Table 4. The coefficient in column 2 suggests that a 1-percentage point increase in tariffs is associated with a reduction in the formality premium by 0.67 percentage points, after controlling for the share of skilled workers and industry unionization.

To put the economic significance of column 2 results in context, consider the liberalization of the motor vehicles industry as an example. The results imply that the decline in tariffs that this industry saw from 38.5% in 1998 to 19% in 2006 was, on average, associated with an increase in the relative formality premium of about 13% ($0.67 \times (0.385 - 0.19) \times 100$). Column 4 tells a similar story, although with a different interpretation: on average, the change in the relative formality premium for the average industry over 1998-2006 narrows by 0.58 percentage points for a 1-percentage point increase in the *initial* tariff level, after controlling for initial share of skilled workers and initial share of union members.

These results are similar in sign and magnitude to the formal-informal wage differential found in Mexico following the NAFTA-induced trade liberalization (Alemán-Castilla, 2006). They are also broadly consistent with evidence of widening wage inequality between formal and informal workers in Brazil (Paz, 2014) but contrasts the evidence for Colombia where the effect of trade policy on industry wages did not vary across formal and informal workers (Attanasio et al., 2004).

Table 5. IV estimation: The effect of trade policy on the industry formal-informal wage differentials

	Instrument: Tariff 1998 * oil price			
	(1)	**(2)**	**(3)**	**(4)**
	Panel A: 2SLS results			
Tariff	-0.693	-0.676*	-0.409	-0.581*
	(0.446)	(0.341)	(0.290)	(0.332)
Share of union members		-0.546*		-0.054
		(0.279)		(0.380)
Share of skilled workers		0.026		-0.479
		(0.244)		(0.317)
Constant	0.367***	0.499**	-0.049	0.255
	(0.113)	(0.185)	(0.083)	(0.197)
Dependent variable form	Levels	Levels	Change	Change
Year indicators	Yes	Yes	No	No
Obs.	61	61	29	29
R-squared	0.08	0.20	0.06	0.22
	Panel B: First-stage 2SLS regressions			
Tariff 1998 * oil price	0.011***	0.0128***	0.010***	0.012***
	(0.001)	(0.001)	(0.002)	(0.002)
Kleibergen-Paap weak-id 1st stage *F*-stat	5.57	11.11	5.70	14.94
Anderson-Rubin $\chi2$ test (*p*-val)	0.0021	0.0043	0.0426	0.0307
Wooldridge $\chi2$ test (*p*-val)	0.0126	0.0331	0.7697	0.5851
R-squared	0.53	0.61	0.58	0.71

*Note. Panel A reports results from the second stage of the 2SLS model. The dependent variable in the second stage is the estimated formal-informal wage differential. Panel B includes only the coefficients on the instrument from the first stage of the 2SLS. Robust Huber-White standard errors clustered at 2-digit industry level are in parenthesis. Kleibergen-Paap Wald weak-id F-statistic is a test of weak identification of instruments that is robust to the violations of the i.i.d assumption of the errors, which is the case here. Anderson-Rubin Wald test provides a weak-identification-robust inference that is also robust to non-i.i.d errors. Wooldridge test is a $\chi2$ test of the endogeneity of the instrumented variables – analogous to the Hausman test with the only difference being that it permits the use of robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.*

The strong relationship we find between tariff reductions and the expanding wage gap between formal and informal workers within industries exposed to trade appears to align with the empirical findings of Selwaness and Zaki (2015) and Salem and Zaki (2019), which indicate a strong contraction in informal employment as manufacturing industries in Egypt undergo greater trade liberalization. In tables A7 and A8 in Appendix, we run further analysis on this aspect using the probability of informal employment as the dependent variable in equations (1) and (2); the results are confirmatory. The convergence of these findings may underscore the potential economic impact of trade liberalization on formal and informal labor dynamics, where tariff reductions are associated with both widening wage disparities and shifts in [in]formal employment.

6.3. Robustness checks

To test the robustness of our results, we proceed in three ways. First, we explore whether using alternative measures alters our conclusions. Second, we investigate whether labor reforms moderate the effect of trade liberalization on the informality premium. Third, we examine whether the observed changes in informal employment stem from within-industry changes, or from broader shifts in the composition of employment across industries due to inter-industry labor reallocation.

First, in addition to tariffs, we added alternative trade performance variables—namely import penetration and export orientation. These are defined, respectively, as the share of imports in domestic absorption (output minus exports plus imports) and the ratio of exports to total output. As shown in Table 6, the tariff coefficient remains negative and statistically significant, even after introducing these additional measures of trade openness. This seems to suggest that tariffs continue to play a central role in explaining the wage differential between formal and informal workers, reinforcing our baseline findings.

Table 6. Alternative variables and the wage differentials

	Formal-informal wage differentials		
	(1)	**(2)**	**(3)**
Tariff	-0.30**	-0.29**	-0.30**
	(0.12)	(0.12)	(0.12)
Imp. Penet.	-0.02		-0.03
	(0.04)		(0.08)
Exp. Orient.		0.01	-0.01
		(0.05)	(0.10)
Share of union members	-0.34	-0.31	-0.35
	(0.31)	(0.30)	(0.26)
Share of skilled workers	0.22	0.19	0.22
	(0.28)	(0.29)	(0.27)
Constant	0.29***	0.29**	0.30**
	(0.10)	(0.12)	(0.13)
Year indicators	Yes	Yes	Yes
Industry indicators	No	No	No
Obs.	47	47	47
R-squared	0.149	0.169	0.170

*Note. Robust standard errors clustered at 2-digit industry level are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1*

Second, we explore whether the effect of trade on the wage differential is moderated by labor reforms, especially the introduction of lax labor regulation in 2004. The intuition is that these reforms have actively sought to reduce rigidities in the labor market, primarily through relaxing the cost of hiring and firing workers, which may have affected labor outcomes for informal workers following tariff cuts. To explore this possibility, we allow the effect of the trade policy variable on the outcomes of interest to vary across the years before and after the 2004 labor reforms. This is done by adding a dummy variable that takes a value of one in 2006 (post-reform) to Equation (2)

as well as an interaction term between this dummy variable and the tariff variable. While we do not attempt attribution here due to the lack of industry-level data that would have enabled us to proxy for labor regulation, the coefficient on the interaction term could point to the importance of labor market regulation when investigating labor market adjustment to trade policy reforms.

Table 7. Labor reforms and the link between the trade policy and the wage differentials

	Formal-informal wage differentials		
	Baseline: WLS		IV
	(1)	(2)	(3)
Tariff	-0.190*	-0.262*	-0.284*
	(0.111)	(0.151)	(0.162)
Tariff * Post labor reform	-0.253	-0.079	-0.205
	(0.219)	(0.230)	(0.188)
		(0.114)	
Share of union members		-0.329	-0.248
		(0.272)	(0.249)
Share of skilled workers		0.170	0.166
		(0.303)	(0.280)
Constant	0.240***	0.353*	0.424**
	(0.071)	(0.181)	(0.171)
Year indicators	Yes	Yes	Yes
Industry indicators	No	No	No
Obs.	61	47	61
1st stage *F*-stat			
Tariff=0	–	–	366.69
Tariff * Post labor reform=0	–	–	31.23
R-squared	0.13	0.27	0.25

*Note. Robust standard errors clustered at 2-digit industry level are in parenthesis. For brevity, only second stage results of 2SLS are reported. In column (3), the dependent variable is in levels form. *** p<0.01, ** p<0.05, * p<0.1.*

Columns 1—3 in Table 7 reports the results for the formal-informal wage differentials. Across the board, the main coefficient on the tariff variable remains statistically significant and does not change signs although the magnitude differs compared to the original specifications. The coefficients on the interaction term in columns 1—3 imply a negative trade—informality relationship, indicating more flexibility in the labor market may have actually shielded informal workers by potentially limiting the disparity in relative wages with their formal counterparts. This relationship is statistically insignificant from zero, however, whether using baseline WLS specifications (columns 1—2) or IV estimates (column 3). Thus, while labor reform may have influenced the effect of tariff cuts on the wage gap between formal and informal workers within tradeable industries, the data does not provide conclusive support for this claim.

Third, our data show that the share of informality in total wage employment increased by 0.4 percentage points, or 12%, during the period of analysis (see Table A3 in Appendix). Central to this paper is to ask whether this observation stems from changes in informal employment within industries, or from changes in industries' employment composition due to inter-industry reallocation of labor. If the latter offers a perceptible margin of adjustment in industries exposed to trade, say, workers move from contracting to relatively expanding industries, then relating trade

policy to informality changes within industries only is likely to bias the estimates downwards. To check whether trade policy did not invoke such labor reallocation mechanism, we regress the share of industry employment on tariffs in a specification that includes industry and time fixed effects as follows:

$$s_{jt} = \beta_1 T_{jt} + \lambda_t + \eta_j + \mu_{jt} \quad (3)$$

where s_{jt} is the share of workers industry *j* at time *t*, T_{jt} is the tariff for industry *j* at time *t*, λ_t and η_t are time and industry fixed effects, respectively. μ_{jt} is an error term. Robust Huber-White standard errors clustered by industry are used to address general forms of heteroscedasticity and serial correlation.

Table 8. Tariffs and industry employment in industries exposed to trade, 1998—2006

	All	Excluding agriculture	Manufacturing
	(1)	(2)	(3)
Tariff	0.007	0.007	0.003
	(0.005)	(0.005)	(0.003)
Constant	0.009***	0.006***	0.008***
	(0.001)	(0.001)	(0.001)
Year indicators	yes	yes	yes
Industry indicators	yes	yes	yes
F-stat	159.17	22.30	35.85
Obs.	61	56	43
R-squared	0.21	0.19	0.20

*Note. Robust standard errors clustered at 2-digit industry level are in parenthesis. The dependent variable is share of industry employment and is calculated as the number of workers in industry j divided by total number of workers in all industries. Tariffs are expressed in fractional points. *** p<0.01, ** p<0.05, * p<0.1*

The results are presented in Table 8 for three specifications: (a) all tradeable sectors; (b) all tradeable excluding agriculture; (c) manufacturing only. The coefficients on tariffs are virtually zero and always statistically insignificant from zero, suggesting that small changes in industry employment shares cannot be related to trade reforms. We find this consistent with the notions of labor market rigidities in developing countries and restricted short-run labor reallocation in response to economic reforms (see, for example G&P, 2003; McCaig and McMillan, 2020). Taken together, these results strengthen the interpretation that the observed changes in the informality wage premium are driven primarily by within-industry adjustments rather than shifts in employment composition across industries. This reinforces the central argument of the paper: in a period characterized by a major trade reform, the within-industry demand for informal workers provides a significant margin of adjustment.

7. Conclusion

This paper investigates the effect of trade policy reforms on informal employment in Egyptian industries exposed to trade during 1998-2006. The results confirm that the informal sector provides

a significant margin of adjustment to trade policy shocks, presumably because of the lower rigidity and easier labor reallocation it grants. The findings corroborate that, in this context, informal employment took the brunt of labor market adjustment to trade reforms. Tariff reductions experienced by the average industry in the tradeable sector has led to an increase in the industry wage gap between formal and informal workers. This holds after controlling for industry-specific characteristics, time effects, and after relaxing the exogeneity assumption using IV estimation. The results also show that labor market regulation had no significant bearing on the adjustment of the informal sector to trade reforms. The wage differential between formal and informal workers was smaller after a new labor law that reduced firing costs was introduced, though the effect is statistically insignificant.

Whether or not reducing informality is a desirable policy objective is not in itself a subject of study in this paper. Several insights with relevance to policymakers, however, emerge from the paper's findings, especially when contextualized within the broader Egypt's literature. First, trade liberalization by itself can be a way to reduce informality within sectors with trade exposure. Second, the informal sector may potentially lose its benefit of working as a buffer at times of negative trade policy shocks, aggravated by a widening gap between its wages and the wages paid in the formal sector. Third, a shrinking and a less competitive informal sector would not be able to cushion the effect of transitional unemployment following the liberalization of trade; that said, this should be interpreted with some caution as the empirical strategy in this paper ignores equilibrium effects and does not consider industries not exposed to trade.

Further research is needed to understand *overall* labor market dynamics following trade liberalization while also focusing the analysis on industries in the non-tradable sector that host a large share of informal employment. This can also help refine the analysis by examining a wider set of mechanisms that can explain the observed labor market outcomes for informal workers—including shifts between tradable and non-tradable employment as well as interregional migration. Adopting a local labor market approach whereby exposure to trade – and potentially enforcement of labor regulation – is measured at the regional level rather than at the industry level can be useful.

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Appendix

Table A1. Simple MFN applied tariffs by industry, 1998—2006

Industry		Tariff rate (%) 1998	2006	Δ (1998 – 2006)	% change
Agriculture, hunting, forestry, and fishing					
01	Agriculture, hunting and related service	18.96	6.62	-12.33	-65
02	Forestry, logging and related service	14.01	2.36	-11.65	-83
05	Fishing, fish hatcheries and farms	17.19	5.88	-11.30	-66
Mining and quarrying					
10	Mining of coal and lignite	3.28	2.14	-1.14	-35
11	Extraction of crude petroleum and natural gas	6.25	4.25	-2	-32
14	Other mining and quarrying	12.54	2.70	-9.83	-78
Manufacturing					
15	Manufacture of food and beverages	106.56	102.54	-4.02	-4
16	Manufacture of tobacco	68.75	22	-46.75	-68
17	Manufacture of textiles	37.51	20	-17.51	-47
18	Manufacture of wearing apparel	39.77	37.71	-2.05	-5
19	Manufacture of leather	31.76	23.17	-8.58	-27
20	Manufacture of wood and wood products	23.02	14.24	-8.77	-38
21	Manufacture of paper and paper products	22.01	12.05	-9.95	-45
22	Publishing and printing	20.04	11.39	-8.65	-43
23	Manufacture of coke and refined petroleum	9.87	5.93	-3.94	-40
24	Manufacture of chemicals	13.05	6.70	-6.34	-49
25	Manufacture of rubber and plastic	27.13	12.61	-14.52	-54
26	Manufacture of other non-metallic products	25.18	13.57	-11.61	-46
27	Manufacture of basic metals	15.38	7.74	-7.63	-50
28	Manufacture of fabricated metals	23.25	14.24	-9.01	-30
29	Manufacture of machinery and equipment	12.12	7.96	-4.16	-34
30	Manufacture of office, accounting, and computing machinery	11.91	2.26	-9.65	-81
31	Manufacture of electrical machinery	18.06	8.95	-9.10	-50
32	Manufacture of radio, TV, and communication equipment	17.98	9.82	-8.15	-45
33	Manufacture of medical equipment	13.01	9.19	-3.82	-29
34	Manufacture of motor vehicles	38.51	19.09	-19.42	-50
35	Manufacture of other transport equipment	11.29	7.15	-4.14	-37
36	Manufacture of furniture; Manufacturing N.E.C	27.29	20.82	-6.47	-24

Source: Author's calculations based on WTO IDB data.

Table A2. Characteristics of formal and informal workers, 1998—2006

Variable	Formal				Informal			
	1998		2006		1998		2006	
	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Individual characteristics								
Urban	0.768	0.422	0.676	0.468	0.528	0.499	0.405	0.491
Male	0.761	0.427	0.759	0.428	0.851	0.356	0.779	0.415
Age	40.428	11.098	39.749	11.233	32.158	14.409	33.604	14.085
Household head	0.603	0.489	0.628	0.483	0.392	0.488	0.431	0.495
Work experience	20.563	13.16	20.267	12.778	17.086	15.428	18.407	15.258
Married	0.786	0.410	0.810	0.392	0.497	0.500	0.600	0.490
Read & write	0.088	0.284	0.057	0.231	0.113	0.317	0.078	0.269
Primary education	0.089	0.285	0.073	0.260	0.145	0.352	0.132	0.339
Preparatory education	0.053	0.224	0.042	0.201	0.069	0.253	0.052	0.223
Secondary & vocational education	0.292	0.455	0.352	0.478	0.201	0.401	0.278	0.448
Post-secondary education	0.108	0.310	0.073	0.261	0.028	0.164	0.022	0.146
University & above	0.289	0.453	0.322	0.467	0.050	0.218	0.058	0.234
Household characteristics								
Household size	5.368	2.408	4.841	2.140	6.649	3.130	5.960	2.994
Number of children (0-14 yrs) in household	1.708	1.582	1.421	1.363	2.155	1.941	1.740	1.757
Number of inactive adults (>14 yrs) in household	1.764	1.458	1.572	1.276	2.186	1.521	1.723	1.356
Household owned and fully paid for	0.521	0.500	0.553	0.497	0.722	0.448	0.745	0.436
Job characteristics								
Permanent job	0.964	0.186	0.935	0.247	0.635	0.481	0.777	0.416
Hours worked per day	6.011	0.646	5.898	0.666	6.677	1.859	6.251	1.369
Work in a micro-enterprise (1—4 employees)	0.269	0.444	0.339	0.474	0.584	0.493	0.708	0.455
Work in a 10 or more person establishment	0.636	0.482	0.569	0.495	0.173	0.379	0.116	0.320
Paid leave	0.883	0.321	0.792	0.406	0.005	0.074	0.008	0.089
Sick leave	0.882	0.323	0.785	0.411	0.005	0.069	0.008	0.090
Maternity leave	0.964	0.188	0.922	0.269	0.286	0.469	0.227	0.424
Medical insurance	0.791	0.407	0.729	0.445	0.004	0.061	0.005	0.070
Paid incentives & other bonuses	0.573	0.495	0.677	0.468	0.013	0.113	0.022	0.148
Paid for overtime	0.077	0.267	0.112	0.316	0.006	0.079	0.011	0.102
Member in a trade union	0.500	0.500	0.511	0.500	0.030	0.171	0.015	0.120

Source: ELMPS 1998 and 2006.Table A3 – Share of wage employment and informality, by industry 1998—2006

Table A3. Share of wage employment and informality, by industry 1998—2006

Industry		Share of employment			Share of informality		
		1998	2006	% change	1998	2006	% change
Agriculture, hunting and forestry, and fishing		0.086	0.083	-3	0.836	0.819	-2
01	Agriculture, hunting and related service	0.081	0.078	-3	0.836	0.815	-2
02	Forestry, logging and related service	0.000	—	—	1.000	—	—
05	Fishing, fish hatcheries and farms	0.005	0.004	-8	0.826	0.848	3
Mining and quarrying		0.004	0.004	-3	0.350	0.167	-52
10	Mining of coal and lignite	0.000	—	—	—	—	—
11	Extraction of crude petroleum and natural gas	0.001	0.003	114	—	—	—
14	Other mining and quarrying	0.002	0.001	-46	0.583	0.400	-31
Manufacturing		0.163	0.142	-13	0.373	0.399	7
15	Manufacture of food and beverages	0.031	0.030	-3	0.401	0.380	-5
16	Manufacture of tobacco	0.002	0.001	-53	0.091	0	-100
17	Manufacture of textiles	0.021	0.017	-22	0.248	0.299	21
18	Manufacture of wearing apparel	0.015	0.017	16	0.726	0.561	-23
19	Manufacture of leather	0.005	0.004	-25	0.739	0.741	0
20	Manufacture of wood and wood products	0.010	0.005	-52	0.860	0.892	4
21	Manufacture of paper and paper products	0.002	0.003	61	0.125	0.500	300
22	Publishing and printing	0.006	0.005	-7	0.333	0.308	-8
23	Manufacture of coke and refined petroleum	0.006	0.007	18	0.067	0.055	-18
24	Manufacture of chemicals	0.012	0.012	-7	0.098	0.250	154
25	Manufacture of rubber and plastic	0.002	0.001	-22	0.111	0.273	145
26	Manufacture of other non-metallic products	0.012	0.013	15	0.491	0.539	10
27	Manufacture of basic metals	0.006	0.004	-38	0	0.107	—
28	Manufacture of fabricated metals	0.012	0.011	-6	0.667	0.699	5
29	Manufacture of machinery and equipment	0.009	0.007	-22	0.133	0.073	-45
30	Manufacture of office, accounting, and computing machinery	0.000	—	—	—	—	—
31	Manufacture of electrical machinery	0.003	0.001	-72	0	0.429	—
32	Manufacture of radio, TV, and communication equipment	0.002	0.001	-42	0.091	0.100	10
33	Manufacture of medical equipment	0.001	0.001	-46	0.167	0.400	140
34	Manufacture of motor vehicles	0.002	0.002	-17	0.200	0.154	-23
35	Manufacture of other transport equipment	0.003	0.001	-70	0.067	0.286	329
36	Manufacture of furniture; Manufacturing N.E.C	0.019	0.020	8	0.837	0.910	9
Services		0.728	0.751	3	0.261	0.315	21
All industries		—	—	—	0.340	0.380	12

Source: ELMPS 1998 and 2006.

Note. Share of employment is calculated as the number of workers in industry j divided by total number of workers in all industries. Share of informality is calculated as the ratio of informal workers in industry j to total number of workers in industry j.

Table A4. Real hourly wages (in EGP) for wage workers, by industry 1998—2006

Industry		Formal		Informal		Unadjusted wage gap	
		1998	2006	1998	2006	1998	2006
Agriculture, hunting and forestry, and fishing		1.52	1.93	1.44	2.00	1.04	0.96
01	Agriculture, hunting and related service	1.48	1.94	1.43	2.00	1.04	0.97
02	Forestry, logging and related service	—	—	2.14	—	—	—
05	Fishing, fish hatcheries and farms	2.31	1.70	1.89	2.32	1.20	0.73
Mining and quarrying		1.42	2.45	1.26	2.00	1.12	1.22
10	Mining of coal and lignite	2.20	—	—	—	—	—
11	Extraction of crude petroleum and natural gas	1.78	2.50	—	2.50	—	1
14	Other mining and quarrying	1.08	2.38	1.26	1.19	0.85	1.99
Manufacturing		1.75	1.76	1.38	1.42	1.27	1.24
15	Manufacture of food and beverages	1.48	1.69	1.23	1.42	1.20	1.18
16	Manufacture of tobacco	1.27	1.60	0.71	—	1.78	—
17	Manufacture of textiles	1.34	1.39	1.19	1.20	1.12	1.15
18	Manufacture of wearing apparel	1.48	1.34	0.99	1.22	1.50	1.10
19	Manufacture of leather	1.65	1.78	2.23	1.38	0.74	1.28
20	Manufacture of wood and wood products	2.60	2.50	1.68	1.86	1.54	1.34
21	Manufacture of paper and paper products	1.34	1.54	0.91	1.32	1.46	1.16
22	Publishing and printing	2.41	1.90	1.86	1.21	1.29	1.56
23	Manufacture of coke and refined petroleum	2.23	2.60	1.76	1.50	1.26	1.73
24	Manufacture of chemicals	1.78	1.79	1.29	0.96	1.38	1.84
25	Manufacture of rubber and plastic	1.57	1.30	1.07	2.22	1.40	0.58
26	Manufacture of other non-metallic products	1.86	1.82	1.48	1.78	1.25	1.01
27	Manufacture of basic metals	1.86	1.82	—	1.04	—	1.75
28	Manufacture of fabricated metals	1.78	2.00	1.19	1.70	1.50	1.17
29	Manufacture of machinery and equipment	2.12	1.86	1.67	1.14	1.26	1.62
30	Manufacture of office, accounting, and computing machinery	2.68	—	—	—	—	—
31	Manufacture of electrical machinery	1.78	2.40	—	1.04	—	2.30
32	Manufacture of radio, TV, and communication equipment	2.38	1.81	1.48	2.50	1.60	0.72
33	Manufacture of medical equipment	1.53	1.04	—	1.32	—	0.78
34	Manufacture of motor vehicles	1.93	1.82	1.61	1.44	1.19	1.25
35	Manufacture of other transport equipment	1.92	2.04	2.38	3.25	0.80	0.62
36	Manufacture of furniture; Manufacturing N.E.C	1.86	2.49	1.98	2.08	0.93	1.19
Services		1.61	1.80	1.40	1.41	1.15	1.28
All industries		1.62	1.85	1.42	1.58	1.14	1.17

Source: ELMPS 1998 and 2006.

Note. All figures are median real hourly wages. The unadjusted wage gap is calculated as the ratio of formal wages to informal wages of workers of the same industry. A ratio greater than one indicates that formal wages are relatively higher than informal wage. 1998 wages are adjusted to inflation and reported in 2006 EGP (inflation factor is 1.43).

Table A5. Description of variables used in the regressions

Variable	Description
First-stage regressions (source: Egypt Labor Market Survey)	
Urban	= 1 if urban, 0 rural
Male	= 1 if male, 0 female
Age	in years
Work experience	Constructed as the survey year minus the year of entry into labor force
Education	Categorical variable indicating the highest level of education attained by an individual: 1) illiterate and no education; 2) read & write but no education; 3) primary education; 4) preparatory education; 5) secondary & vocational education, equivalent to intermediate education; 6) post-secondary education, equivalent to above-intermediate education; 7) university and above
Married	= 1 if married, 0 otherwise
Household head	=1 if household head, 0 otherwise
Household size	The number of individuals in the household
Inactive adult hh members	Number of unemployed household members aged between 15 and 65
Informal	= 1 if informal, 0 formal. A worker is informal if the worker is not covered by either a legal contract or social contract
Region	Dummy variables for the region of residence: 1) Greater Cairo; 2) Alexandria & Suez; 3) urban Lower Egypt; 4) urban Upper Egypt; 5) rural Lower Egypt; 6) rural Upper Egypt
Union	= 1 if person is a member of a trade union, 0 otherwise
Hourly wage	Real hourly basic wage in EGP – equals the earnings from basic wage, adjusted for number of work days per week and average number of hours worked per day
Second-stage regressions (source: various sources as explained in the text)	
Tariff	Unweighted tariffs (simple average) at the 2-digit industry level expressed in fractional points
Imports	Value of imports in mill EGP at the 2-digit industry level. Source: WITS software based on UN COMTRADE and UNCTAD TRAINS databases
Exports	Value of exports in mill EGP at the 2-digit industry level. Source: WITS software based on UN COMTRADE and UNCTAD TRAINS databases
Output	Domestic output or the value of total production at selling price in mill EGP at the 2-digit industry level. Source: Annual Bulletin of Industrial Production by CAPMAS
Import penetration	Constructed as imports divided by domestic consumption (i.e. output + imports – exports) at the 2-digit industry level
Export orientation	Constructed as exports divided by domestic output at 2-digit industry level
Share of union members	Constructed as the proportion of members of trade unions of total workers at the industry level
Share of skilled workers	Constructed as the proportion of workers with secondary & vocational education or above of total workers at the industry level
Share of private sector workers	Constructed as the proportion of private sector workers of total workers at the industry level
Oil price	World crude oil import prices in USD/barrel. Source: International Energy Agency (IEA) Crude Oil Import Register, adapted from OECD library
Post-labor reform	=1 if year is equal to 2006 (after the 2004 labor reforms), 0 if year is equal to 1998 (before the 2004 labor reforms)

Table A6. First stage results on the log real hourly wage

	1998	2006
Experience	0.036***	0.045***
	(0.007)	(0.007)
Experience * formal	0.008	-0.006
	(0.009)	(0.008)
Experience^2	-0.001***	-0.001***
	(0.000)	(0.000)
Experience^2 * formal	-0.000	0.000*
	(0.000)	(0.000)
Male	0.327***	0.402***
	(0.101)	(0.127)
Male * formal	-0.357***	-0.368***
	(0.105)	(0.127)
Household head	0.037	-0.080**
	(0.050)	(0.035)
Household head * formal	-0.053	0.060
	(0.051)	(0.042)
Married	0.088**	0.085*
	(0.038)	(0.044)
Married * formal	-0.088*	-0.067
	(0.045)	(0.041)
Household size	-0.015**	-0.007
	(0.007)	(0.005)
Household size * formal	-0.007	-0.003
	(0.009)	(0.008)
Inactive adult hh members	0.036*	0.009
	(0.018)	(0.012)
Inactive adult hh members * formal	-0.001	0.013
	(0.021)	(0.016)
Union	0.025	0.221*
	(0.125)	(0.117)
Union * formal	0.061	-0.107
	(0.127)	(0.118)
Read & write	0.112*	-0.095*
	(0.066)	(0.051)
Read & write * formal	-0.129	0.112
	(0.092)	(0.083)
Primary	0.119*	-0.022
	(0.071)	(0.047)
Primary * formal	0.017	0.017
	(0.079)	(0.074)
Preparatory	0.192***	0.044
	(0.067)	(0.043)
Preparatory * formal	-0.015	0.080
	(0.108)	(0.079)
Secondary & vocational	0.234***	0.010
	(0.077)	(0.068)
Secondary & vocational * formal	0.173	0.302**
	(0.107)	(0.127)
Post-secondary	0.334***	-0.012
	(0.110)	(0.087)
Post-secondary * formal	0.137	0.440***
	(0.112)	(0.117)
University & above	0.574***	0.080
	(0.134)	(0.073)
University & above * formal	0.149	0.547***
	(0.126)	(0.125)
Constant	-0.392***	-0.159*
	(0.115)	(0.089)
Industry dummies	Yes	Yes
Region indicators	Yes	Yes
Obs.	4778	7573
R-squared	0.29	0.21

*Note. Robust standard errors clustered at 2-digit industry level are in parenthesis. The dependent variable is log real hourly basic wage. Regressions include industry indicators. *** p<0.01, ** p<0.05, * p<0.1*

Table A7. First-stage results: Normalized industry informality differentials, 1998—2006

Industry		1998	2006
01	Agriculture, hunting and related service	0.354***	0.295***
02	Forestry, logging and related service	0.570***	—
05	Fishing, fish hatcheries and farms	0.408***	0.297***
10	Mining of coal and lignite	-0.280***	—
11	Extraction of crude petroleum and natural gas	-0.333***	-0.310***
14	Other mining and quarrying	0.354***	-0.137***
15	Manufacture of food and beverages	0.024**	-0.040***
16	Manufacture of tobacco	-0.267***	-0.347***
17	Manufacture of textiles	-0.043***	-0.120***
18	Manufacture of wearing apparel	0.210***	0.062***
19	Manufacture of leather	0.327***	0.287***
20	Manufacture of wood and wood products	0.356***	0.311***
21	Manufacture of paper and paper products	-0.244***	0.094***
22	Publishing and printing	-0.041***	-0.065***
23	Manufacture of coke and refined petroleum	-0.160***	-0.206***
24	Manufacture of chemicals	-0.207***	-0.091***
25	Manufacture of rubber and plastic	-0.121***	-0.024**
26	Manufacture of other non-metallic products	0.103***	0.103***
27	Manufacture of basic metals	-0.281***	-0.212***
28	Manufacture of fabricated metals	0.195***	0.197***
29	Manufacture of machinery and equipment	-0.127***	-0.247***
30	Manufacture of office, accounting, and computing machinery	-0.406***	—
31	Manufacture of electrical machinery	-0.290***	-0.115***
32	Manufacture of radio, TV, and communication equipment	-0.195***	-0.211***
33	Manufacture of medical equipment	-0.186***	0.090***
34	Manufacture of motor vehicles	-0.138***	-0.138***
35	Manufacture of other transport equipment	-0.188***	-0.071***
36	Manufacture of furniture; Manufacturing N.E.C	0.321***	0.327***
40	Electricity, gas, steam and hot water supply	-0.234***	-0.251***
74	Other business activities	0.379***	0.088***
92	Recreational, cultural and sporting activities	-0.206***	-0.011***
93	Other service activities	0.377***	0.275***
Standard deviation		0.247	0.222

*Note. Standard deviation is a measure of overall dispersion computed by the Haisken-DeNew and Schmidt (1997) procedure. *** p<0.01, ** p<0.05, * p<0.1*

Table A8. Second-stage results: Effect of trade policy on industry informality differentials

	Pooled cross-sections (1)	First differencing (2)
Tariff	0.208**	0.468*
	(0.101)	(0.242)
Constant	-0.162***	0.067
	(0.043)	(0.042)
Year indicators	Yes	No
Industry indicators	No	No
Obs.	61	29
R-squared	0.07	0.06

*Note. Robust standard errors clustered at 2-digit industry level are in parenthesis. The dependent variable is industry informality differential. *** p<0.01, ** p<0.05, * p<0.*